SOIL EROSION AND SEDIMENTATION CONTROL PLAN

PORTAGE CREEK AREA
TIME CRITICAL REMOVAL ACTION
KALAMAZOO, MICHIGAN

Prepared for:

USEPA Region 5
Emergency Response Branch
77 West Jackson
Chicago, IL 60604
and
The Michigan Department of
Environmental Quality

Contract No. EP-S5-08-02
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EQ Project No.: 030281.0087

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1. INTRODUCTION

1.1 Project Summary

Environmental Quality Management, Inc. (EQ) is performing a Time Critical Removal Action (TCRA) to remove polychlorinated biphenyl (PCB) contaminated sediments from targeted locations over a 1.8-mile section of Portage Creek. The Portage Creek Area Site (Site) is a portion of the Allied Paper/Portage Creek/Kalamazoo River Superfund Site. The Site is located in Kalamazoo County, Michigan, and is pervasively contaminated with PCBs as a result of historic waste practices associated with several paper mills. The Site, which was listed on the National Priorities List (NPL) on August 30, 1990, is located in the City of Kalamazoo, Michigan, beginning at the East Cork Street and flowing northward approximately 3 miles to the confluence of the Kalamazoo River. Activities associated with this removal action are anticipated to occur in segments along a 1.8-mile stretch of Portage Creek. Work activities will occur primarily between Reed Avenue to East Walnut Street bridge, South Pitcher Street bridge to the railroad crossing west of Rochester Street, and the bend in Portage Creek east of Rochester Street to the confluence with the Kalamazoo River. The general approach for dredging of contaminated sediment in Portage Creek involves conducting dry excavations in 10 individual sections, or excavation areas, progressing from the upstream end to the downstream confluence of Portage Creek with the Kalamazoo River. Figure 1-1 provides a Site Location Map, and Figure 1-2 presents a Site Plan showing all excavation segments.

The areas of Portage Creek targeted for action have been divided into distinct removal areas, as shown in Figure 1-2. The areas targeted for dry excavation will be referred to as SA (slope area) 1-A, SA1-B, SA1-C, SA3-A, SA5-A, SA5-C, Axtell Creek, SA5-D, SA6, and SA7. It is anticipated that the project work will span two to four construction seasons subject to funding allocations and seasonal working conditions. The phases may be split over multiple construction seasons as available budget and working conditions permit completion of individual removal areas. It is estimated that preparation activities in removal areas SA6 and SA7 including mobilization and setup of the equipment, materials, personnel, and facilities necessary to

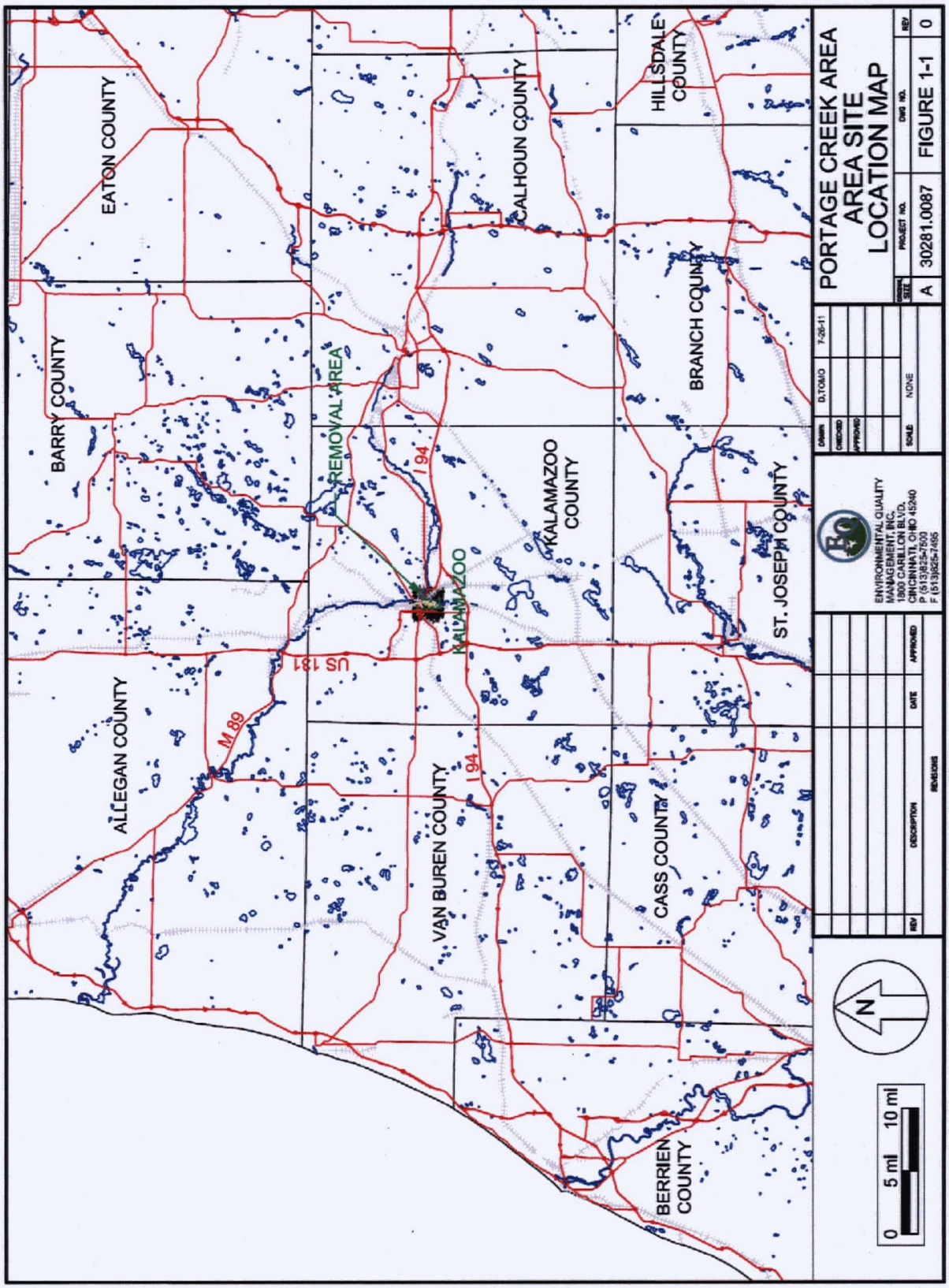

Figure 1-1. Site Location Map

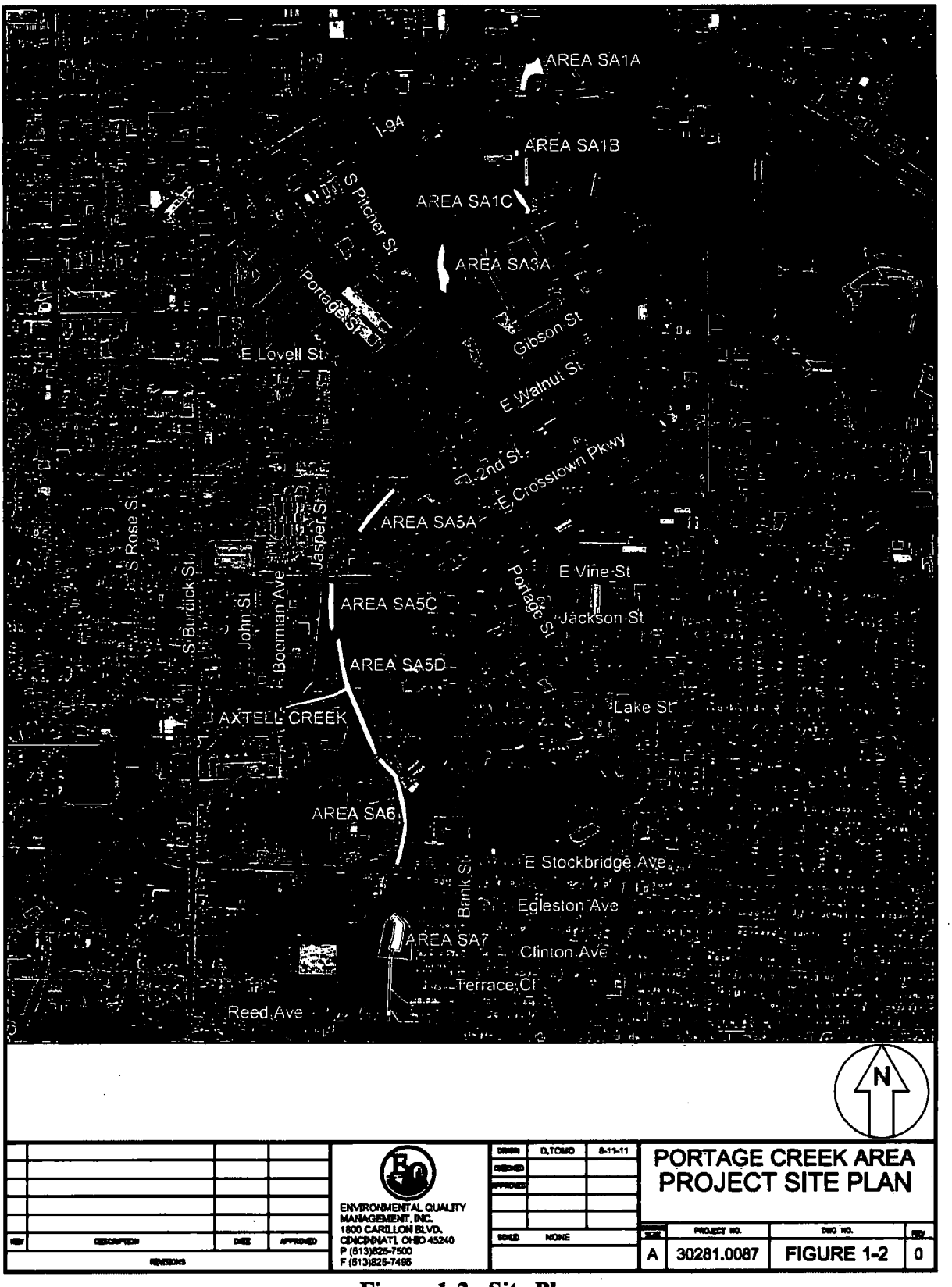

Figure 1-2. Site Plan

complete the project, will begin in late September 2011. The primary project tasks will consist of the following: install appropriate soil erosion and sedimentation controls; mechanically dredge the contaminated sediments from Portage Creek; dewater and solidify the sediments and transport the solidified sediments by truck to a permitted off-site disposal facility; place residual cover aggregate over the dredged areas; conduct all appropriate and required environmental controls and monitoring; and restore the creek in accordance with the project design. A summary of the primary work activities is provided below.

Sediments will be removed from the creek by mechanical dredging techniques, including the use of long-reach excavators equipped with both environmental buckets and standard excavating buckets. Excavation areas in the creek will be isolated by the use of various methods, including installation of steel sheet pile cofferdams and pumping the water around the excavation areas and discharging it back into the creek downstream of the active excavation sites.

Silt curtains will be placed in strategic locations in Portage Creek to control turbidity during sediment excavation. Solidification of creek sediment will take place either in the stream bed or in a miser box immediately adjacent to the stream bed, and then the material will be hauled by dump trucks to the staging area for dewatering.

Recharge groundwater in the excavation, decontamination water, and liquids removed from the sediment dewatering process will be treated at an on-site wastewater treatment plant and discharged back to Portage Creek, in accordance with a Substantive Requirements Document (SRD).

Restoration activities will include returning all disturbed areas to pre-construction conditions. This will involve aggregate placement in the creek; removal of temporary roads and project support structures/facilities; and grading, seeding, and replanting of native perennials that were removed during construction work. Other restoration or environmental enhancement work activities will include, as necessary, installation of coir logs at the toe of the slope and armoring the toe slope portions of the creek with rock.

1.2 Project Objective

The objective of the Portage Creek Time Critical Removal Action is to mitigate threats to public health, welfare, and the environment presented by the presence of a potential uncontrolled release of PCBs from creek channel bottoms, creek bank soils, and floodplain soils located within the Portage Creek Area. Specific removal action objectives for the Portage Creek Area are listed below:

- Stem the potential loading of PCBs to the Kalamazoo River from creek banks and channel bottoms in the Portage Creek Area by removing contaminated sediments and soils.
- Dispose of removed bank soils and sediment containing PCBs off site in a way that does not present unreasonable risk to human health or the environment.
- Mitigate potential adverse environmental impacts of construction.
- Complete restoration activities/habitat enhancement to disturbed areas of removal activities.

The objective of this Soil Erosion and Sedimentation Control Plan is to present an approach and tactics for this contamination removal that will not cause detrimental erosion and sedimentation during project work activities.

1.3 Applicable Laws, Regulations, and Permits

Federal, state, and local guidelines affecting sedimentation and erosion control at the Site are described below.

Part 91, Soil Erosion and Sedimentation Control of the Natural Resources and Environmental Protection Act (NREPA), PA 451 of 1994, regulates activities in the State of Michigan. The regulation requires a permit for earth changes that disturb one or more acres of land or that are within 500 feet of the water's edge of a lake or stream. Soil erosion and sedimentation control programs are administered by various county and municipal agencies. Appendix A contains a copy of this regulation.

Activities at Portage Creek require a soil erosion and sedimentation control permit due to earth changes that disturb more than 1 acre and that occur within 500 feet of the water's edge. The City of Kalamazoo is the enforcing agency for projects located within the City of Kalamazoo that are subject to Part 91. Therefore, activities at the Site will be covered under a Part 91, Soil

Erosion and Sedimentation Control Permit. A copy of this permit, permit application, and approval letter are located in Appendix A.

Requirements of the permit application include development of a Soil Erosion and Sedimentation Control Plan to effectively reduce soil erosion and off-site sedimentation. The plan must include the following components:

- Soils information maps
- Project schedule
- Description and location of physical limits of proposed earth changes
- Description of all temporary and permanent erosion and sedimentation control measures.

Once the permit is issued, it remains valid as long as work is progressing and inspections are requested and conducted. A permit shall become invalid if the authorized work is not commenced within 60 days after issuance of the permit or if the authorized work is suspended or abandoned for a period of 60 days after the time of commencing work.

Under the Clean Water Act, the U.S. EPA developed the National Pollutant Discharge Elimination System (NPDES) Storm Water Program. Phase II of the program addressed construction sites disturbing 1 to 5 acres of land with a point source discharge to water of the state. Michigan Department of Environmental Quality (MDEQ) has been delegated authority to administer the NPDES program in Michigan. Construction activities with a total earth disturbance of 1 or more acres are subject to MDEQ's NPDES Permit by Rule. However, construction activities that disturb 1 to 5 acres do not need to submit a Notice of Coverage or associated fees to MDEQ because these sites are automatically covered under the Permit by Rule if they have obtained coverage under the Soil Erosion and Sedimentation Control (SESC) Program, in accordance with Part 91, Soil Erosion and Sedimentation Control of NREPA.

Activities in the first construction phase of the project (Fall 2011) will disturb 4 acres of soil; therefore, a Notice of Coverage does not need to be submitted to MDEQ for this construction season. Each phase of the project (or construction season) will be individually assessed in order to determine if the total acreage for that construction season totals 5 acres or greater. If the total acreage of disturbance is equal to or greater than 5 acres for a particular project phase, then a NPDES Notice of Coverage will be submitted to MDEQ for Permit by Rule coverage, prior to any work beginning in that phase.

EPA has proposed and promulgated several regulations (40 CFR 112), consistent with the National Contingency Plan and the directives of the Federal Water Pollution Control Act, to prevent the discharge of oil and hazardous substances into the waters of the United States. The requirements of 40 CFR 112 (Oil Pollution Prevention) apply to owners and operators of onshore, non-transportation-related facilities that could potentially discharge oil in harmful quantities into or upon navigable waters of the United States. The regulations apply to facilities that store oil in the following amounts:

- Greater than 1,320 gallons aboveground, or
- Greater than 42,000 gallons underground.

EQ does not intend to store petroleum products at the work area above the threshold amount. Therefore, the Oil Pollution Prevention regulations do not apply to activities performed under this project. Section 5 of this Sedimentation and Erosion Control Plan presents a Spill Emergency Contingency Plan that addresses potential spill sources, spill response and cleanup, spill notification, and spill reporting.

1.4 Organization of the Plan

This plan is organized to meet the requirements of a Soil Erosion and Sedimentation Control Plan as required by the Soil Erosion and Sedimentation Control Permit issued by the City of Kalamazoo. Section 1 of the plan presents the purpose, organization of the plan, and applicable laws, regulations, and permits. The location and description of the Site, and the Site evaluation and assessment are presented in Section 2. Section 3 describes the soil erosion and sedimentation controls in place at the Site. Common best management practices and other site controls are presented in Section 4. Section 5 discusses potential spill sources, spill response, spill notification, and spill reporting. Maintenance and site inspections are discussed in Section 6. Section 7 provides information on recordkeeping and training. Lastly, Section 8 presents the management certification of the Plan.

2. SITE EVALUATION, ASSESSMENT, AND PLANNING

2.1 Project/Site Information

The Portage Creek Time Critical Removal Action site is located in Kalamazoo, Kalamazoo County, Michigan. The location of the northernmost point of the project area (the confluence of Portage Creek and the Kalamazoo River) is latitude 42° 17′ 43″ N and longitude 85° 34′ 23″ W. A Site Location Map is provided as Figure 1-1. The Portage Creek Area removal project begins at East Alcott Street and extends north approximately 1.8 miles to the confluence of Portage Creek with the Kalamazoo River. The creek has an average width of 32 feet and an average depth of 2.3 feet. The approximate total removal area will be 8.2 acres over the 4-year span of the project term.

The removal areas associated with work being performed in the first term of the project (Fall 2011) consist of an approximate total of 4 acres. The creek is bounded by developed and undeveloped residential, commercial, industrial, and city-owned properties for its entire length through the City of Kalamazoo. Upjohn Park is located adjacent to a portion of the Portage Creek project area. Figure 1-2 provides a Site Plan for the project area. There are 18 bridge crossings and more than 50 storm water outlets in the contaminated sediment removal areas. The banks of Portage Creek range in height from 18 inches to 10 feet. Certain locations in the Portage Creek Area have limited access and may require heavy equipment to gain access into the creek bed to remove contaminated sediments. In the southern portion of Portage Creek, the water flow is moderately fast and strong, while the flow rate decreases considerably as the creek nears the confluence with the Kalamazoo River.

Several paper companies doing business along the Kalamazoo River between 1954 and the early 1970's recycled large quantities of carbonless copy paper. The carbonless paper required de-inking before re-pulping could occur. Carbonless paper contained PCBs as an ink carrier until 1971. Allied Paper de-inked and re-pulped large amounts of carbonless paper at areas located directly upstream of the Portage Creek Project Area. Wastewater from the de-inking process

contained large quantities of suspended solids consisting of cellulose and clay that contained high concentrations of PCBs.

2.2 Contact Information/Responsible Parties

Contact information and responsibilities of the individuals associated with this project are listed below. Any subcontractors expected to work at the site will be notified of soil erosion and sedimentation control requirements applicable to their work.

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2.3 Nature and Sequence of Construction Activity

A project schedule for the first phase of the project is provided in Appendix B. This schedule presents the timeframe of construction activities for excavation areas SA6 and SA7. The schedule may be updated to reflect changes as the project progresses. Section 3 provides

detailed information regarding the soil erosion and sedimentation controls timing, installation, and usage at excavation areas SA6 and SA7.

A tentative project schedule including all four phases of the project over a 2- to 4-year term is described below. The project schedule for Phases 2 through 4 is subject to change based upon funding availability, weather conditions, and other factors.

Phase 1 Overview—Construction activities can begin when the final design has been completed and approved by U.S. EPA and necessary rights of access are obtained. It is estimated that preparation activities in Removal Areas SA7 and SA6, including mobilization and setup of the equipment, materials, personnel, and facilities necessary to complete the project, will begin in September 2011. Preparation activities, which are described in detail in Section 3, will include building access roads and staging areas, clearing and grubbing vegetation, and installing temporary soil and sedimentation control measures. Excavation of SA7 and dredging of SA6 are currently expected to be carried out in Phase 1 in the first construction season in 2011. Excavation of SA6 and SA7 will result in a combined removal of an estimated 3,438 cubic yards (cy) of soil consisting of approximately 325 cy of Toxic Substances Control Act (TSCA) sediment waste and 3,113 cy of Subtitle D sediment waste.

Phase 2 Overview—To avoid the challenges associated with winter work in southwest Michigan, active work will shut down over the winter months of 2011 and resume in the spring of 2012, dependent on water levels within the creek. Phase 2 will include excavation within Removal Areas SA5-D, and Axtell Creek. Phase 2 is expected to be completed in the second construction season during the spring and summer of 2012. Excavation of SA5-D and Axtell Creek will result in a combined removal of an estimated 5,200 cy of soil consisting of approximately 1,530 cy of TSCA sediment waste and 3,670 cy of Subtitle D sediment waste.

Phase 3 Overview—Phase 3 will include excavation within Removal Areas SA5-C and SA5- A. Phase 3 is expected to be completed in the third construction season during the spring and summer of 2013. However, work may begin in the second construction season, if available budget and acceptable working season is suitable for completion of one or both of these designated sections. Excavation of SA5-C and SA5-A will result in a combined removal of an

estimated 4,126 cy of soil consisting of approximately 2,394 cy of TSCA sediment waste and 1,727 cy of Subtitle D sediment waste.

Phase 4 Overview—Phase 4 will include excavation within Removal Areas SA3-A, SA1-C, and SA1-A. Phase 4 is expected to be completed in the fourth construction season during the spring and summer of 2014. However, work may begin in the third construction season if available budget and acceptable working season is suitable for total completion of one or multiple designated sections. Excavation of SA3-A, SA1-C, and SA1-A will result in a combined removal of an estimated 4,149 cy of soil consisting of approximately 590 cy of TSCA sediment waste and 3,559 cy of Subtitle D sediment waste.

2.4 Soils, Slopes, Vegetation, and Current Drainage Patterns

According to the Soil Survey of Kalamazoo County, Michigan, United States Department of Agriculture Soil Conservation Service, soils in the Portage Creek project area are characterized as Ub, Urban land and Ug, Urban land-Glendora complex. The Ub complex is composed of areas so obscured by urban work and structures that identification and characterization of the soil is not possible. Figure 2-1 shows a Soils Map and Figure 2-2 shows the Legend for the project area.

The Ug, Urban land-Glendora complex is characterized by nearly level areas of urban land, very poorly drained, rapidly permeable soils on floodplains along perennial streams and rivers. These soils formed in sandy alluvium with slopes of 0 to 2 percent. Urban land makes up to 40 to 60% of the map unit and the Glendora soil makes up to 20 to 40%. The Urban land areas and Glendora soils are so intricately mixed or so small in size that it is not practical to separate them in mapping. Typically, the Glendora soil has a surface layer of black sandy loam about 10 inches thick. The underlying material to a depth of about 60 inches is alternate layers of multi-colored sand with thick layers of black loamy sand and muck. The Glendora soil has rapid permeability, slow runoff, and low water available water capacity. In undrained areas, the seasonal high water table is within 1 foot of the surface during November to June. The potential is poor for cropland, woodland, recreation, and building site development due to flooding. It is ideal for development of wildlife wetland habitat.

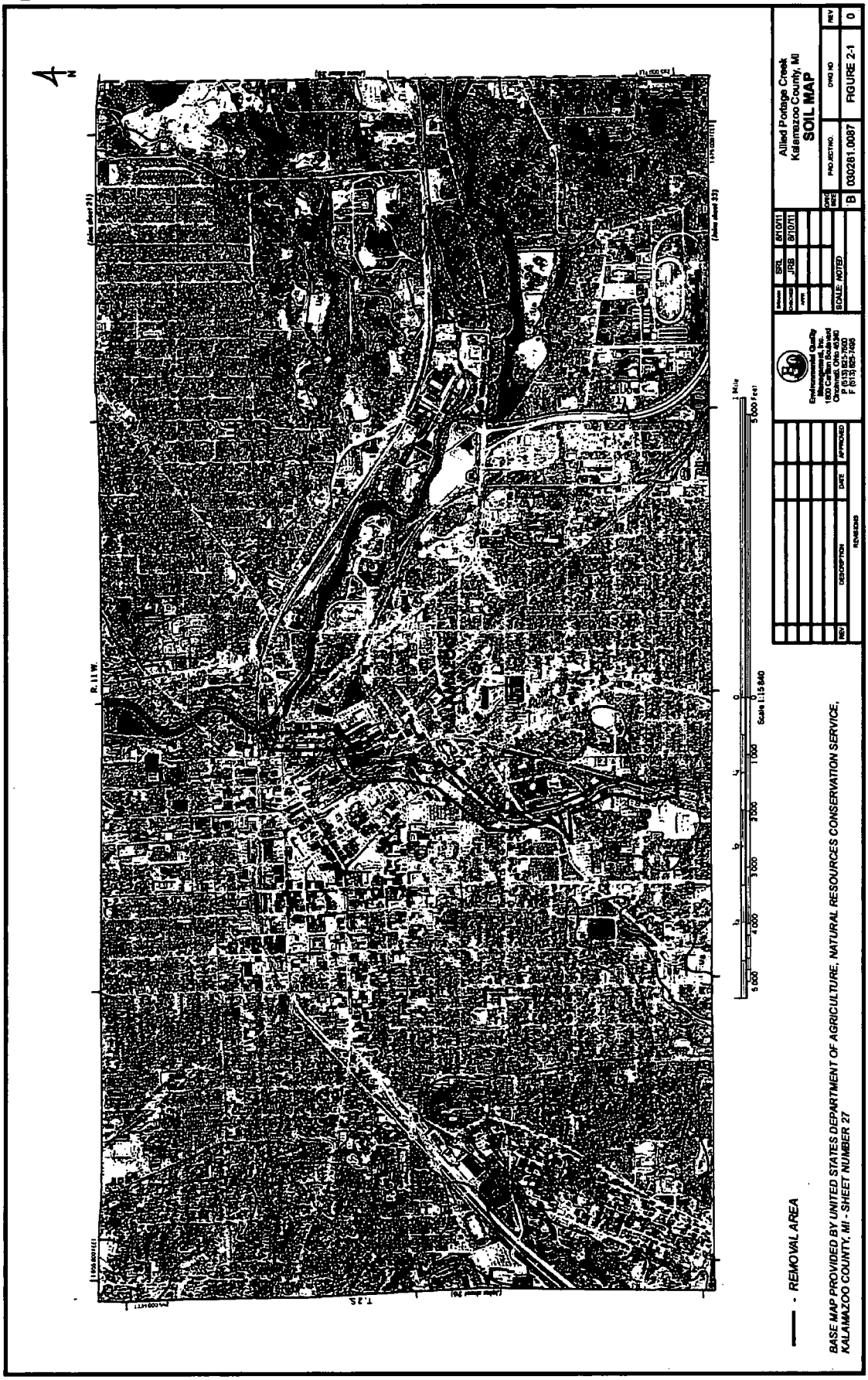


Figure 2-1. Soils Map

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate
- Federal
- State
- County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label)
- Located object (label)
- Tank (label)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
- Double-line (label)
- Drainage end/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (scalic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot

SOIL LEGEND

Each symbol consists of two or three letters. The first letter is a capital and it is the first letter of the map unit name. The second letter is lower case and it is used to separate map units that begin with the same first letter. The third letter is a capital and it indicates the class of slope. Symbols without a slope letter are used for map units which do not have slope as part of the name.

SYMBOL	NAME
Ad	Adrian muck
BdA	Brady sandy loam, 0 to 3 percent slopes
BnA	Brenton sandy loam, 0 to 3 percent slopes
CaB	Cidenas loamy sand, 0 to 6 percent slopes
CnC	Coloma loamy sand, 6 to 12 percent slopes
CnD	Coloma loamy sand, 12 to 18 percent slopes
DaA	Donnegan loam, 0 to 3 percent slopes
Ed	Edwards muck
Gd	Gilford sandy loam
Gn	Glendora sandy loam
Gy	Granby loamy sand
Hn	Houghton muck
Hs	Houghton and Sebewa soils, ponded
KaA	Kalamazoo loam, 0 to 2 percent slopes
KeB	Kalamazoo loam, 2 to 6 percent slopes
KeC	Kalamazoo loam, 6 to 12 percent slopes
OaB	Oshtemo sandy loam, 1 to 6 percent slopes
OaC	Oshtemo sandy loam, 6 to 12 percent slopes
OaD	Oshtemo sandy loam, 12 to 18 percent slopes
OaE	Oshtemo sandy loam, 18 to 25 percent slopes
Pb	Pits, gravel
PfB	Plainfield loamy sand, 0 to 6 percent slopes
RkB	Riddles loam, 2 to 6 percent slopes
RkC	Riddles loam, 6 to 12 percent slopes
SaA	Schoolcraft loam, 0 to 2 percent slopes
SaB	Schoolcraft loam, 2 to 6 percent slopes
Sb	Sebewa loam
SeA	Sloan loam, 0 to 3 percent slopes
SgB	Spinks loamy sand, 0 to 6 percent slopes
SgC	Spinks loamy sand, 6 to 12 percent slopes
SgD	Spinks loamy sand, 12 to 18 percent slopes
SZE	Spinks–Oshtemo loamy sands, 18 to 25 percent slopes
ThA	Thetford loamy sand, 0 to 2 percent slopes
Ua	Udipsamments, level to steep
Ub	Urban land
Ug	Urban land–Glendora complex
UkB	Urban land–Kalamazoo complex, 0 to 6 percent slopes
UkC	Urban land–Kalamazoo complex, 6 to 12 percent slopes
UoD	Urban land–Oshtemo complex, 12 to 25 percent slopes

Figure 2-2. Soil Map Legend

The stream bank slopes of Portage Creek vary along its length. In the upstream areas slopes can be greater, especially along SA6-1 through SA6-4. As the creek makes it way toward its confluence with the Kalamazoo River, the stream bank slopes flatten considerably. Portage Creek has an average width of 32 feet and an average depth of 2.3 feet. The banks of Portage Creek range in height from 18 inches to 10 feet.

Two complete bathymetric and topographic surveys of the Site will be conducted. The initial survey will be conducted prior to construction, and the final survey will be conducted after construction to match existing grades, where possible.

As operations are completed within a removal area, the banks will be reconstructed to a stable condition and revegetated. The goal of the stable bank design is to have the banks withstand a bank full flow without major erosion or damage. Maintaining the lower bank elevation or the same elevation as the opposite bank is critical to maintaining the frequency and duration of inundation in floodplain wetlands as the river water level rises with storm flows.

Existing vegetation in the Portage Creek project area consists of native and invasive plant species including grasses, herbaceous plants, woody tree species, perennial flowers, and weed species. Some areas along Portage Creek are forested on both sides of the banks, and others are covered by brushy vegetation. In some areas, stream banks are without vegetation.

The vegetated areas to be cleared and grubbed will be identified through the use of marking paint, survey tape, and flags. The areas of disturbance are delineated in Figures 3-1 and 3-3. Vegetation located within the areas to be disturbed will be removed prior to construction activities. However, EQ will only remove vegetation that obtrudes, encroaches upon, or otherwise obstructs construction activities. Trees and vegetation to be left standing will be protected from damage from construction activities through the installation of orange construction fence along the perimeter of the areas to be disturbed. In addition, areas within 5 feet of trees will be cleared by hand, and vegetation will be left standing in order to provide sufficient protection.

Trees, stumps, and stubs to be cleared, except where clearing is done by uprooting with machinery, should be cleared as close to ground surface as possible but not more than 6 inches

aboveground for small trees and 12 inches for larger trees. Trees designated to be left standing within the cleared areas will be trimmed of dead branches 1 ½ inches or more in diameter and will be trimmed of all branches at heights indicated. Limbs or branches to be trimmed will be neatly cut close to the bole of the tree or main branches, and cuts more than 1 ½ inches in diameter will be painted with an approved tree-wound paint. Material to be grubbed, logs, and other organic debris not suitable for foundation purposes will be removed to grade level. Depressions made by grubbing will be filled with approved fill material and compacted to make sure the surfaces conform to the original adjacent ground surface.

Following soil removal actions, all disturbed areas along Portage Creek will be restored by seeding bare areas with an appropriate seed mix, and re-vegetating with native grasses, shrubs, and trees, with the objective of improving both the hydraulic and ecologic functioning of the channel and adjacent riparian corridor and floodplain.

Storm water from surrounding areas (residential, commercial, public lands, park areas) discharges to Portage Creek through at least 50 storm water outfalls located along the creek. Portage Creek flows north and discharges to the Kalamazoo River. The Kalamazoo River flows north and west, ultimately discharging to Lake Michigan. Overall drainage patterns in the Portage Creek drainage area will remain unchanged. In some cases, as a result of this project, drainage will be enhanced and the erosive potential of Portage Creek will be reduced.

2.5 Construction Site Estimates

The information provided below demonstrates that the Portage Creek Area Time Critical Removal Action will not alter land use or increase storm water runoff in the project area.

Total project area: ..... 4 acres
Area of disturbance:
Soil removal: ..... 1.36 acres
Staging areas, dewatering areas, wastewater treatment, etc. ..... 2.7 acres
Percentage of impervious area before construction: 0%
Percentage of impervious area after construction: 0%
Runoff coefficient prior to construction: ..... 0.1 - 0.25
Runoff coefficient following construction: ..... 0.1 - 0.25

2.6 Site Features and Sensitive Areas to be Protected

Along Portage Creek there are numerous features that will require protection, including bridges, trees not to be removed, storm water outfall pipes, and fencing. Trees and vegetation to be left standing will be protected from damage from construction activities through the installation of orange construction fence along the perimeter of the areas to be disturbed. In addition, areas within 5 feet of trees will be cleared by hand and vegetation will be left standing in order to provide sufficient protection.

Care will be taken when dredging and soil removal activities are taking place near and under bridge. A structural engineer will be employed to assess and inspect the bridges, review bridge design features, and perform a records search of the bridges. The goal is to stay away from bridges, except where removal actions underneath the bridge are required. In this case, other precautions will be implemented as necessary. As an example, the footbridges spanning the confluence of Portage Creek and the Kalamazoo River require sediment removal from underneath the bridges; therefore, excavation equipment will be downsized and HDPE mats will be used as a roadway for excavation equipment.

Storm water outfall pipes that discharge into the creek will be protected by an isolation process. Sheet pile cofferdams will be constructed around storm water outfalls, and storm water emanating from the outfalls will be pumped downstream. A backup pump will be in place as a safeguard in case of failure of the primary pumps. Storm water outfalls may also be stabilized with riprap.

Fencing located along the Portage Creek will only be removed when absolutely necessary for access to the creek. Following completion of removal activities in a particular segment of the creek, fencing will be promptly replaced.

2.7 Potential Sources of Pollution and Water Quality

Table 2-1 provides a list of potential sources of sediment and other pollutants which may reasonably be expected to affect the water quality of Portage Creek during excavation activities.

Construction activities will be kept under surveillance, management, and control to avoid pollution of surface and ground waters. EQ will establish a water quality monitoring program to ensure protection of surface waters. The water quality monitoring program is described in more detail in the Work Plan. In general, EQ will monitor turbidity in Portage Creek. In the event action levels are exceeded (i.e., monitoring location 2x background level), additional monitoring may be conducted and/or the site activities will be discontinued. Corrective actions will be evaluated and implemented as necessary. In addition, any evidence of an oil sheen will be immediately reported to the Site Manager and corrective actions will be implemented (e.g., absorbed with oil boom, etc.), if necessary.

2.8 Endangered Species Certification and Other Affected Species

A review was conducted of the Federal- and State-Listed Endangered and Threatened Flora and Fauna Species of Michigan, Kalamazoo County. Based on the information provided in Table 2-2, the following federal and state endangered and threatened species are present in Kalamazoo County. Consultation did not identify endangered or threatened species within the defined limits of the project area, except for the Indiana bat. The Indiana bat (Myotis sodalist) is listed as an endangered species by the U.S Fish and Wildlife Service (USFWS) in the general vicinity of the project area. The bats hibernate in caves over the winter, and then migrate to summer habitat in wooded areas where they usually roost under loose bark on dead or dying trees. Habitat has been identified in the project area that has the potential to accommodate the Indiana bat. A site survey will be conducted to identify trees in the project area where the Indiana bat might roost if tree removal is required during summer habitat periods.

Other species present in the project area that could potentially be affected by excavation activities are:

- Bald Eagle
- Humans (children)–contamination adjacent to Upjohn Park
- Large/smallmouth/rock bass, bluegill, catfish, carp

Table 2-1. Potential Sources of Sediment and Other Pollutants

Removal Action Site Pollutants									
	Primary Pollutant		Other Pollutants						
Area of Consideration	**PCBs**	**Sediment**	**Phosphorus and Nitrogen**	**Metals (FE & Mn)**	**pH**	**Pesticides & Herbicides**	**Oil & Grease**	**Trash, Debris**	**Calci-ment®**
Clearing, grubbing, and excavating	X	X						X	
Contaminated soil removal	X	X							
By-pass Pumping	X	X		X					
Demolition and debris disposal	X	X						X	
Material delivery and storage		X				X	X	X	
Solidification		X							X
Contaminated spills		X			X	X	X		
Vehicle/equip-ment fueling							X		
Vehicle/equip-ment use and storage		X					X		
Channel and bank restoration		X	X			X		X	
Restoration planting		X	X					X	

Table 2-2. Endangered and Threatened Species of Kalamazoo County, Michigan

Common Species Name	Federal Status	State Status
Indiana bat	Endangered	Endangered
Mitchell's satyr	Endangered	Endangered
American burying beetle	Endangered	Presumed extirpated
Eastern Massasauga	Being Considered	-
Gattinger's gerardia	-	Endangered
Henslow's sparrow	-	Endangered
Cream wild indigo	-	Endangered
Kitten-tails	-	Endangered
Side-oats grama grass	-	Endangered
Straw sedge	-	Endangered
American chestnut	-	Endangered
Kirtland's snake	-	Endangered
Creek chubsucker	-	Endangered
White gentian	-	Endangered
Bowman's root	-	Endangered
Climbing fern	-	Endangered
Prairie vole	-	Endangered
Pugnose shiner	-	Endangered
Orange- or Yellow-fringed Orchis	-	Endangered
Swamp or Black Cottonwood	-	Endangered
Regal fritillary	-	Endangered
Fleshy stitchwort	-	Endangered
Blanchard's cricket frog	-	Threatened
Beaked agrimony	-	Threatened
Slippershell	-	Threatened
Tall green milkweed	-	Threatened
Purple milkweed	-	Threatened
Western silvery aster	-	Threatened
Canadian milk vetch	-	Threatened
Cut-leaved water parsnip	-	Threatened
Narrow-leaved reedgrass	-	Threatened
Sedge	-	Threatened
Spotted turtle	-	Threatened
Lake herring	-	Threatened
Prairie coreopsis	-	Threatened
Yellow fumewort	-	Threatened
Least shrew	-	Threatened
Purple wartyback	-	Threatened
White ladyslipper	-	Threatened
Cerulean warbler	-	Threatened
Beak grass	-	Threatened
Leiberg's panic grass	-	Threatened

Table 2-2. (continued)

Common Species Name	Federal Status	State Status
Creeping whitlow grass	-	Threatened
Small log fern	-	Threatened
Flattened spike rush	-	Threatened
Persius dusky wing	-	Threatened
Upland boneset	-	Threatened
Queen-of-the-prairie	-	Threatened
Umbrella grass	-	Threatened
Showy orchis	-	Threatened
Stiff gentian	-	Threatened
Downy sunflower	-	Threatened
Goldenseal	-	Threatened
Frosted elfin	-	Threatened
Whorled pogonia	-	Threatened
Scirpus-like rush	-	Threatened
Leggett's pinweed	-	Threatened
Virginia flax	-	Threatened
Virginia water-horehound	-	Threatened
Ginseng	-	Threatened
Bog bluegrass	-	Threatened
Louisiana waterthrush	-	Threatened
Wild rice	-	Threatened

Disturbance of or damage to fish, wildlife, and flora will be minimized or prevented throughout the 4-year span of the project. Disturbance to birds that may use the area is possible, although most bird species would avoid the area during operations and would return shortly after project completion. Short-term adverse impacts that may occur would include temporary disruption of small mammals, deer, reptiles, amphibians, waterfowl, songbirds, and shorebirds that may use the facility for resting or feeding.

As previously described, areas at each site in which activities will occur and areas that will not be disturbed have been identified. EQ does not anticipate the need for additional ground disturbance beyond those areas identified that would minimize any potential impact to flora and wildlife. In addition to providing protection of water quality, erosion control measures will also control disturbance to aquatic species. For example, installation of the silt curtain will prevent migration downstream of potentially contaminated sediment/water.

The goal of this time critical removal action is to remove PCB-contaminated soils so that further contamination of fauna species of Portage Creek and the Kalamazoo River does not occur. The restoration component of the project takes into account the potential species in the area and provides habitat enhancement for them by adding native flora species to the ecosystem.

2.9 Historic, Cultural, and Archaeological Preservation

A review was conducted of the Michigan Historic Preservation Office National Register of Historic Places along with a review of the Michigan Office of the State Archaeologist. It was determined that at this time one historical, archaeological, or cultural resource may be located on or near the project site. According to the Michigan Office of State Archaeologist, an archaeological site may be located at the confluence of the Kalamazoo River and Portage Creek. This location is not anticipated to be excavated until construction year 3 or 4. In accordance with Michigan Office of State Archaeologist regulations, an application for Section 106 Review will be completed and submitted to the Office of State Archaeologist in a timely manner prior to excavation activities commencing in this section of the Portage Creek Time Critical Removal project area.

In the event any previously unidentified or unanticipated resources are discovered during excavation or other construction activity, all activities that may damage or alter such resources will be temporarily suspended, until protection measures can be employed such as installing fencing or signs around the resource. In addition, employees will be prevented from trespassing on, removing, or otherwise damaging such resources. The Federal On-Scene Coordinator (FOSC) or designated Government representative will be notified immediately upon discovery of these resources.

3. SOIL EROSION AND SEDIMENTATION CONTROL BMPs

3.1 Installation of Erosion and Sedimentation Controls

The areas of disturbance at the Site are presented in Figures 3-1 and 3-3. Detailed soil erosion and sedimentation controls for Portage Creek segments SA6 and SA7 are presented below. Appendix C contains the State of Michigan DEQ Guidebook of Best Management Practices for Michigan Watersheds, which provides detailed information and diagrams of the specific erosion and sedimentation control measures that will be employed at SA6 and SA7. Section 6 of this plan provides information on maintenance and inspections that must be performed for each soil erosion and sedimentation control measure.

Detailed soil erosion and sedimentation controls for the remainder of the Portage Creek Area segments that will be excavated throughout subsequent construction seasons and under subsequent soil erosion and sedimentation control permits will be appended to this Plan prior to the start of excavation activities in each construction year.

3.2 SA6 Soil Erosion and Sedimentation Controls

Figure 3-1 presents the soil erosion and sedimentation control measures to be used during excavation activities in Portage Creek segment SA6. Portage Creek segment SA6 is divided into grid boundaries SA6-1 through SA6-14. Activities in SA6 will occur in uninterrupted succession in three distinct sections:

- SA6-1 through SA6-4
- SA6-5 through SA6-8
- SA6-9 through SA6-14

Excavation in sections SA6-5 through SA6-8 will take place using a long-reach excavator from atop the western bank of Portage Creek progressing in a downstream direction. Sections SA6-1 through SA6-4 and SA6-9 through SA6-14 will consist of a different approach. Excavation within these sections will take place within the creek bed progressing in a downstream direction for Sections SA6-1 through SA6-4 and in an upstream direction for Section SA6-9 through

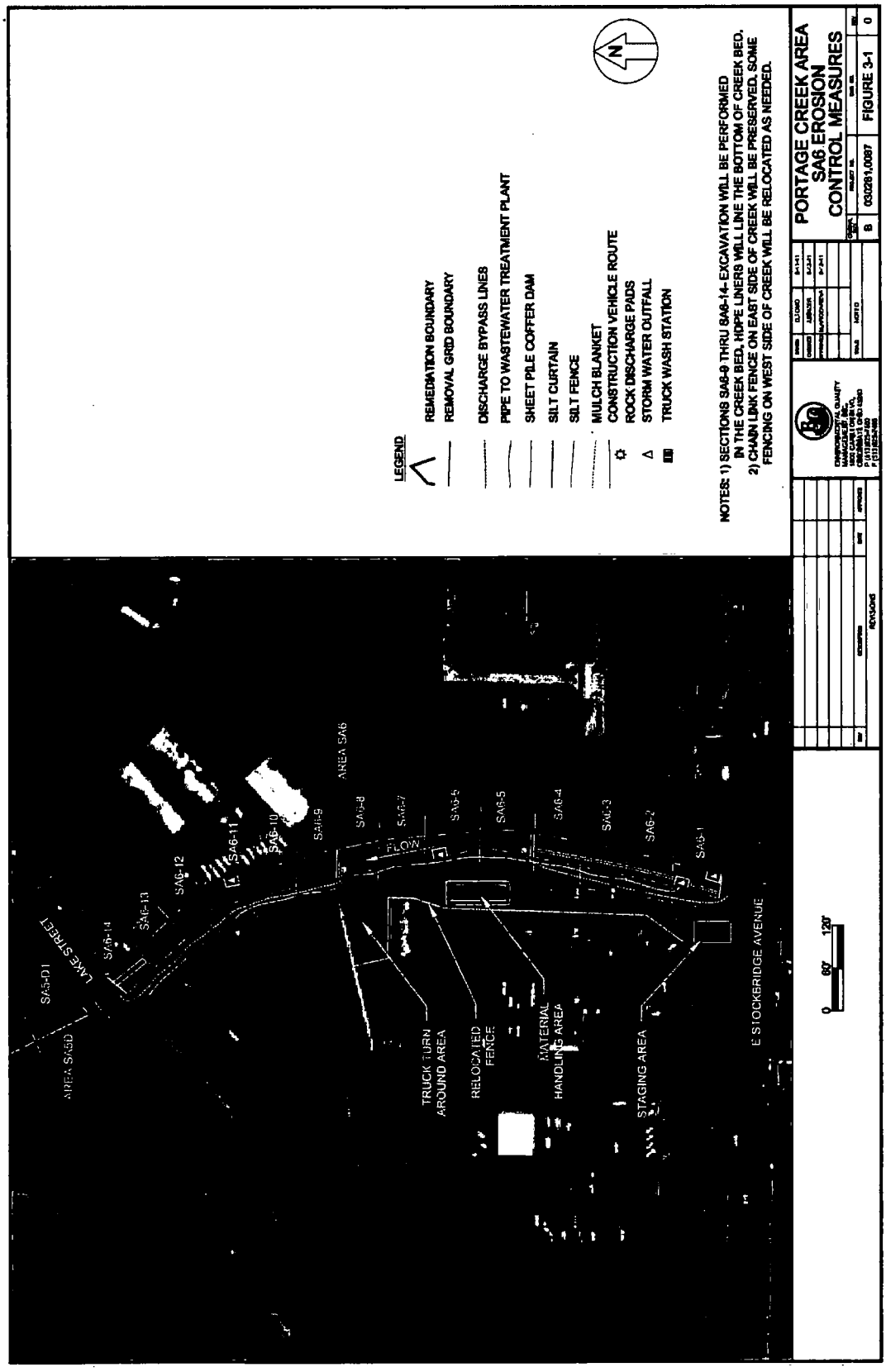


Figure 3-1. SA6 Erosion Control Measures During Construction

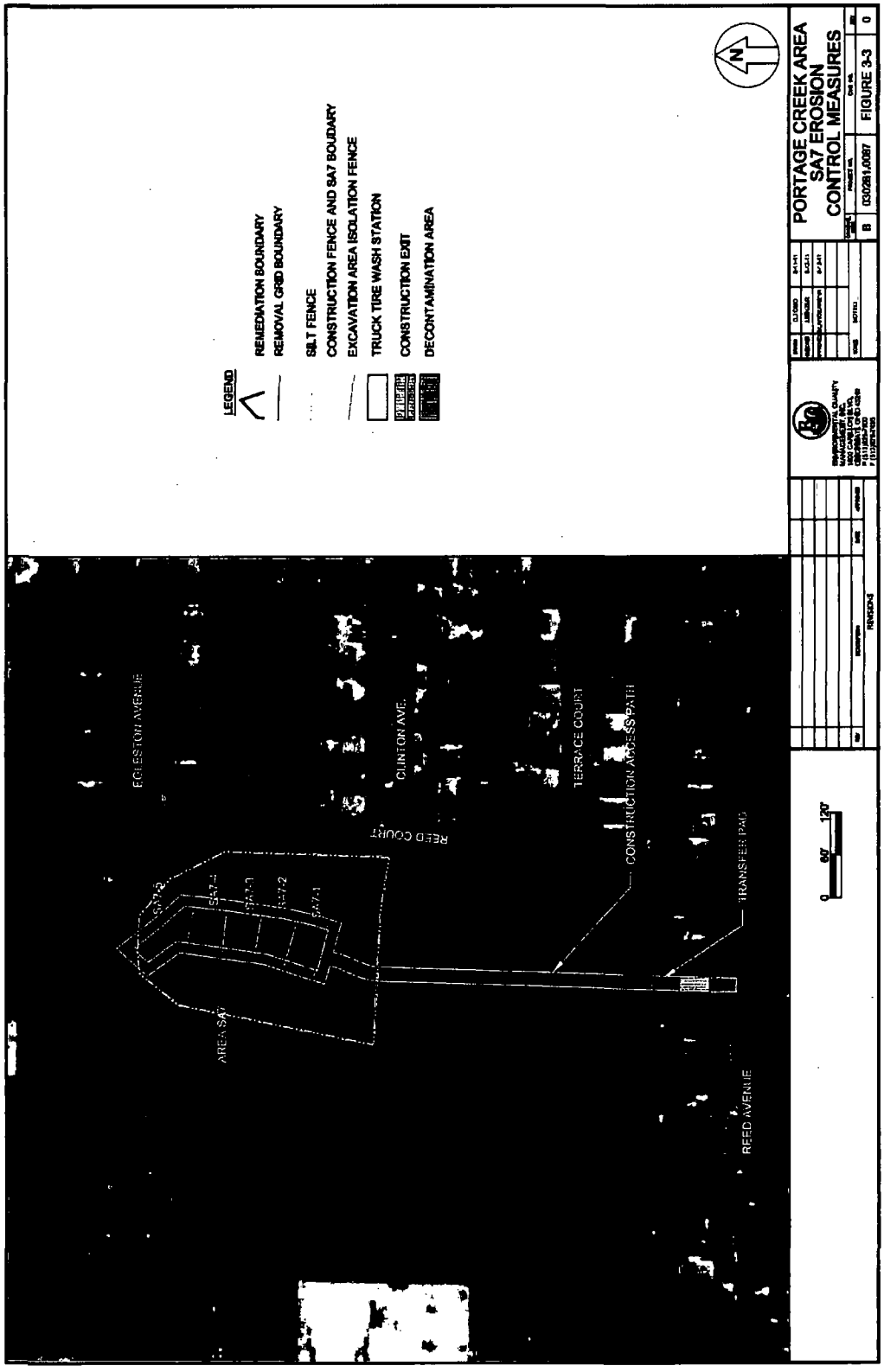


Figure 3-3. SA7 Erosion Control Measures During Construction

SA6-14. Dredging will be performed by constructing a temporary access road into the creek bed utilizing HDPE road mats and by utilizing smaller excavating equipment within the creek bed to remove contaminated sediments.

The excavator will be outfitted with a ground positioning device that will have survey information loaded to guide the excavator operator in precise removal of contaminated sediments. The excavator will also be equipped with a smooth cutting edge bucket to prevent the excavator's bucket teeth from driving contaminated soils deeper.

Prior to excavation activities, clearing and grubbing activities will take place along the western bank of the Portage Creek channel and as needed to clear the overhanging vegetation of the eastern bank. This will facilitate the dewatering and wastewater pipeline installation, in addition to providing access for the long-reach excavator and the smaller excavation equipment. Clearing will be performed in a manner that will leave the root mass intact in order to better maintain soil stability. Tree trunks will be removed only to ground level to preserve root structure.

A dewatering line will be installed from the wastewater treatment plant at the command post to Portage Creek. The dewatering line will follow the west bank of Portage Creek to the Lake Street bridge. The pipeline will be installed under the bridge and will continue to run parallel to the bank, along the west side, and extend to the bridge at Stockbridge Avenue. A brush hog mower mounted on a posi-track loader will be used to perform the majority of the clearing for the dewatering line. Laborers equipped with chain saws will remove (if needed) trees to ground level. Tree trunks and branches <8 inches will be processed through a wood chipper to create wood mulch. This mulch will be stockpiled for later use as ground cover in designated areas throughout the site. Vegetation will only be removed down to ground surface elevation in order to protect root systems and thus maintain soil stability along the creek.

A series of sheet pile cofferdams will be installed across the creek bed beginning at SA6-1 and ending at SA6-4. Surface water and ground water will be pumped out of the area between the cofferdams and will be directed downstream to the wastewater treatment plant through the dewatering pipeline discussed above. By-pass pumps will be set above the upstream cofferdam to redirect stream flow around the isolated section. This will be repeated for Sections SA6-5

through SA6-8 and SA6-9 through SA6-14. Smaller 3-sided sheet pile cofferdams will be installed around the four outfalls that are in the excavation area. Bypass pumps situated at each outfall will pump storm water discharging from the outfalls downstream of the excavation area. In this manner, the normal creek flow, including the storm water discharges from four outfalls along the length of SA6, will be diverted around the isolated active excavation area.

Soil erosion and sedimentation controls will be installed after clearing and grubbing and prior to excavation activities. The following measures will be employed.

3.2.1 Access Road Construction

An access road will be constructed at SA6 along the eastern edge of the city-owned paved lot west of Portage Creek and in the southeastern corner of the lot which is either currently covered with vegetation or covered with asphalt/concrete pavement. The construction access road will allow construction equipment and workers to enter and leave the work areas while preventing soil from traveling off site. In order to build this access road, vegetation will be cleared in the southeastern portion of the property. Trees and vegetation will need to be removed in order to construct the construction access, truck wash station, and staging area in the southeastern corner of the city-owned property. The truck wash station will be located at the terminus of the construction access path, immediately to the west of the East Stockbridge Avenue bridge.

A designated truck turnaround area will be located at the north end of the access road near the city-owned maintenance buildings. Construction trucks will enter the construction access road at East Stockbridge Avenue at the top of the bank near the bridge and travel north to the material handling area where materials will be loaded onto the trucks. From there, the trucks will proceed to the turnaround area and then proceed south to exit the construction area through the truck tire wash station. Stockbridge Avenue at the entrance to the construction access road will be swept as needed with a power broom with water induction capabilities in order to keep it as free of material as possible. Sections of the access road that utilize pre-existing pavement will also be swept as needed.

A portion of the perimeter chainlink fence along the east side of the Kalamazoo Public Services Property will need to be relocated to the west to accommodate the construction of the access road

and maintain security for the Kalamazoo Public Services Property. This will also require installation of additional fencing and access gates in designated areas. Chainlink fence will be installed along the entire length of the construction access road in order to prevent construction equipment from traveling outside of the designated area and to prevent unauthorized persons and vehicles from entering the construction zone. The fence will be constructed of 6-ft-tall industrial grade chainlink fence fabric with line posts at 10-ft intervals. EQ will reuse acceptable portions of the fencing fabric and ancillary materials and supplement with like-and-kind new materials as needed to relocate the fence constructed with equal and/or similar design specifications.

Temporary access gates (chainlink) will be installed and maintained at the construction entrance to restrict vehicular access when work activities are not occurring. Signs posted at the construction entrance will direct construction-related personnel to sign in at the appropriate project support area. The temporary access gate at the SA6 construction access road entrance will be closed and locked during night-time hours and on weekends.

The existing roadways surrounding the Site will be inspected daily to ensure sediment is not tracked off site. Material tracked onto paved public roads will be removed on a daily basis and will not be swept into roadside ditches. In the event material is identified on the public roadways, corrective actions will be immediately implemented. Small amounts of material will be swept up via brooms and dustpans. Street sweeping may be performed if necessary.

3.2.2 Truck Tire Wash Station

The staging area at SA6 will be equipped with a decontamination truck tire wash station to wash truck tires prior to leaving the site. The truck tire wash station will be constructed immediately north of the point where the construction access road meets East Stockbridge Avenue and east of the material handling area between stockpile/loadout area and the construction entrance. The truck tire wash station will be contained and equipped with an impermeable liner. EQ does not anticipate generating a large volume of water from tire washing at this location due to the relatively small amount of soil being shipped off site. Therefore, waste wash water generated will be drummed and transferred to the TCRA Support Area for subsequent disposition.

Truck tire washes help to prevent material being transported from the project site and onto public roadways. The truck tire wash station will be inspected to ensure that the wash water is not heavily contaminated with materials cleaned off the truck tires. When the water in the truck wash station needs to be replaced, it will be pumped out with a vacuum truck into 55-gallon drums. The truck tire wash station will be refilled with clean water after the material-laden water is pumped out.

3.2.3 Silt Fence

A silt fence will be installed in SA6-5 through SA6-8 on the west stream bank due to the steeper slopes in this area. Although the cofferdams and by-pass pumping will keep groundwater from entering the dry excavation area during storm events, storm water could erode the stream banks and cause increased suspended solids loading, which could impair the functioning of the wastewater treatment system.

The silt fence will typically be placed on the down-slope side of the disturbed areas. The silt fence will not likely be placed adjacent to other SA6 segments in order to provide proper access to these areas, and because slopes are not as steep in other areas. In addition, excavation work in the other segments will be performed from within the creek bed and not at the top of the creek bank, so creek banks will not be disturbed in these segments. The silt fence may be installed in other areas based on a field decision as the work progresses. A silt fence will also be installed around the perimeter of the staging area and material handling area at SA6. The specifications and installation procedures will comply with State of Michigan's Department of Management and Budget's Soil Erosion and Sedimentation Control Guidebook (Appendix C).

3.2.4 Mulch Blanket

A mulch blanket will be used in conjunction with the silt fence discussed above to prevent storm event erosion in the areas of SA6-5 through SA6-8 that have steep exposed slopes. The stream banks will be stabilized by applying mulch blankets to the stream bank surface parallel to the direction of stream flow. The blankets will be secured in anchor trenches at the head and toe of the slope. Staples will be used to secure the blanket over the slope surface. The mulch blankets will be installed in accordance with manufacturer's specifications and the State of Michigan's

Department of Management and Budget's Soil Erosion and Sedimentation Control Guidebook presented in Appendix C.

3.2.5 Silt Curtain

One or more silt curtains will be installed perpendicularly to the stream flow direction and downstream of the sheet pile cofferdams and by-pass pumping discharge lines in order to contain suspended sediments during dredging operations. EQ will use a combination of semi-permeable and impermeable silt curtains. A solid Type II Turbidity barrier with flotation, anchor chain, and grommeted ends will be utilized to allow for cable connections to additional curtain sections. The Type II Barrier is constructed to deal with high currents, streams, wind, and tidal areas. This heavier curtain was selected to be protective in event of storm surges. The length of skirt on the curtains will vary. The height of the skirt on the curtain will vary depending on the depth of water within the creek. The State of Michigan's Department of Management and Budget's Soil Erosion and Sedimentation Control Guidebook will be used as guidance for installation, maintenance, and inspection of the silt curtain.

3.2.6 Rock Discharge Pad

A rock discharge pad will be placed in all areas in the creek bed where by-pass water discharges downstream of the excavation area, including at storm water outfalls. The geotextile and rock discharge pad will be installed below the water level in order to prevent the oxidation of iron and manganese present in groundwater beneath Portage Creek. EQ may also install rock discharge pads as needed to protect against storm water surges that can cause scouring and erosion of the stream banks and creek bed. Details of the rock discharge pads are provided in Appendix C.

3.2.7 Solidification

If dredged sediments are dry enough to directly load onto transfer dump trucks, the operator will dump sediments into a dump truck positioned under the machine. If sediments require additional drying or solidification, the operator will deposit the sediments along the western bank of the creek bed near excavation areas SA6-5 and SA6-6 or into a stone miser box located on the creek bed downstream from the excavator. Placing the material along the stream bank will allow the free water to flow by gravity into the isolated segment of the creek. If solidification is needed,

the sediments will be placed in a stone miser box or into the creek bed and will be mixed with a solidification agent (Calciment®) to solidify the material prior to disposal. Solidifying the material will reduce the risk of releasing sediment back into the environment during handling and transportation operations. The solidification agent will be supplied by the manufacturer in supersacks or a bulk silo, and will be stored near the excavation area.

3.2.8 Turbidity Monitoring

Construction activities will be kept under surveillance and control to avoid pollution of Portage Creek. A water quality monitoring program to ensure protection of Portage Creek will be established. The water quality monitoring program will include real-time turbidity monitoring and surface water sampling. Portions of the turbidity monitoring program are highlighted below. The turbidity monitoring and surface water monitoring programs are described in more detail in the Work Plan and Field Sampling Plan.

Real time, direct-read turbidity readings will be collected daily during removal activities to identify construction-related contributions, if any, to existing creek turbidity levels. Real-time turbidity monitoring will be performed with stations set 300 ft upstream, 200 ft downstream, and 300 ft downstream of cofferdams set at each area. Turbidity monitoring will be recorded on half-hour intervals by a programmed data logger at the turbidity station. Other readings may be collected based on field conditions such as presence of visible runoff to the creek in the work vicinity, or as part of mitigation measures. Data will be transferred to a computer in the EQ command post trailer via a cellular modem.

Real-time turbidity measurements designed to monitor resuspension control systems will be supplemented by inspections of the control systems. Inspections will be conducted each day at the beginning of removal activities. Inspections will also be conducted, as appropriate, in response to visible sediment plumes migrating from the work area or measured turbidity levels above the action level. If warranted, additional inspections may be conducted following higher-flow periods, a noticeable turbidity increase outside the system, unexpected system position/behavior, contact with the system by equipment or debris, or other abnormal events.

Mitigation measures may be taken based on the turbidity data obtained. If the 300-ft downstream turbidity data is two times (2x) the concurrent upstream data, specific steps will be initiated until the exceedance has been mitigated to below the action level (AL).

For cases where it is necessary to reduce the rate of, or cease, removal activities, removal activities may be resumed (at previous rates) once turbidity readings have been below the action level for 30 minutes, provided that mitigation measures have been completed and unacceptable turbidity levels have not occurred.

3.2.9 Final Stabilization and Restoration

The SA6 restoration activities are presented in Figure 3-2. Restoration activities will include removing infrastructure, establishing a stable slope grade in the excavation areas, reestablishing vegetation, and restoring creek flow to the original channel. Seeding and revegetation activities will occur in the disturbed areas as described below. The State of Michigan's Department of Management and Budget's Soil Erosion and Sedimentation Control Guidebook will be used as guidance for grading and shaping, seeding, and mulching activities.

EQ will conduct restoration activities at the Site as work progresses. For example, EQ will restore disturbed areas once activities in a particular work area are completed. The disturbed areas will generally be seeded with a temporary seed (winter rye) and mulched following completion of work activities and removal of the associated infrastructure within the area. The temporary seed will stabilize the disturbed area and act to control any potential erosion. The temporary seed will generally be applied at a rate of 1 to 3 pounds per 1,000 square feet. Permanent seed may not be applied to the site until the spring season to ensure the seed becomes well established in the disturbed areas. Therefore, during the spring, the areas containing the temporary seed will be slightly tilled, if necessary, and replanted with the permanent seed. The permanent seed will be applied at a rate of approximately 12 pounds per acre. Depending on the timing of the restoration activities, however, the permanent seeding may be performed during the current construction year in certain areas. Permanent seeding will only be performed during periods where acceptable growth could be expected. An annual rye grass, wheat, and/or winter barley will also be applied during application of the permanent seed at a rate of approximately 30

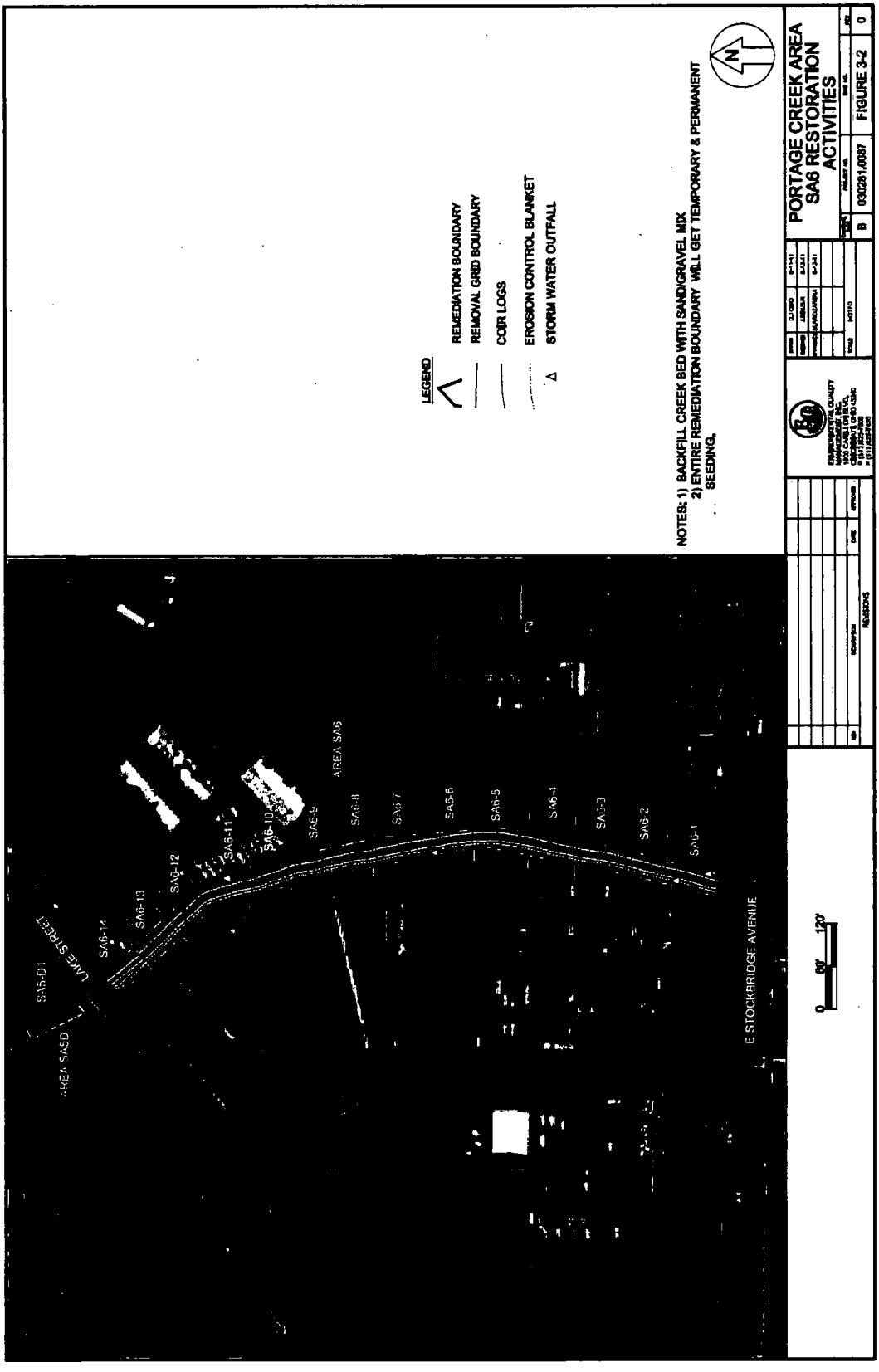


Figure 3-2. SA6 Restoration Activities

pounds per acre. These grasses will provide a temporary cover during development of the permanent seed. Seeding must take place within 5 days of establishment of final grade.

Plants (i.e., mix of herbaceous plants and shrubs) will be planted in certain areas. Oversight personnel will inspect and approve seed mixes before they are applied in order to verify that they are transported in appropriate containers and are labeled with the ratios of the included species, total weight, date of preparation, and source. Oversight personnel will also inspect woody plant materials to verify the correct species and check for insects, diseases, appropriate root development, and/or indicators of excessive stress. Plants that do not appear healthy or of adequate quality for planting will be rejected and replaced with better quality stock. Seeding and woody planting methodologies will be implemented to verify that the materials are handled and installed appropriately.

Revegetation of floodplain forests that extend throughout the Portage Creek area will be accomplished by seeding and planting woody trees and shrubs. Shade-tolerant wetland herbaceous plant species will be included in the seed mix for the floodplain forest habitat to provide ground cover after canopy development. Native trees and shrubs of the species observed in this habitat, as well as other species that typically inhabit and are adapted to periodic inundation, will be planted to a target density observed in tree plots surveyed during habitat characterization efforts. Tree and shrub stock will consist of container stock and/or root-balled trees that will be planted, supported, and protected from herbivory during the monitoring period.

The types of species ultimately selected will depend on availability and input from all appropriate interested parties such as federal, state, and local officials as well as the property owner. Planting will be performed when weather and soil conditions are suitable in accordance with industry practices. Plants will not be planted in areas unsuitable for proper growth. The plant species to consider for planting in the restoration areas are presented in Table 3-1.

Table 3-1. List of Potential Species For Revegetation

Common Name	Scientific Name	Wetland Indicator Status [1]	Emergent Wetland	Forested Wetland	Forested Upland
River Birch[a]	Betula nigra	FACW		X	
Eastern Redbud[a]	Cercis Canadensis	FACU			X
Black Walnut[a]	Juglans nigra	FACU			X
Sycamore[a]	Platinus Occidentalis	FACW		X	
Swamp White Oak[a]	Quercus bicolor	FACW		X	
Pin Oak[a]	Quercus palustris	FACW		X	
Red Oak[a]	Quercus rubra	FACU			X
American Elm[a]	Ulmus Americana	FACW			X
Speckled Alder[b]	Alnus incana	OBL		X	
Black Chokecherry[b]	Aronia Melancarpa	FACW			X
Buttonbush[b]	Cephalanthus occidentalis	OBL		X	
Redosier Dogwood[b]	Cornus sericea	FACW		X	
Alternate-Leaf Dogwood[b]	Cornus alternifolia	NI			X
Silky Dogwood[b]	Cornus Amomum	FACW		X	
Gray-Stem Dogwood[b]	Cornus Racemosa	NI			X
Northern Spicebush[b]	Lindera benzoin	FACW			X
Pussy Willow[b]	Salix discolor	FACW		X	
Elderberry[b]	Sambucus canadensis	FACW		X	
New England Aster[c]	Aster novae-angliae	FACW	X	X	
Tall Coreopsis[c]	Coreopsis tripteris	FAC	X	X	
Joe-Pye-Weed[c]	Eupatorium maculatum	OBL	X	X	
Boneset[c]	Eupatorium perfoliatum	FACW	X	X	
Dense Blazingstar[c]	Liatris spicata	FAC	X	X	
Mountain Mint[c]	Pycnanthemum virginianum	FACW	X	X	
Green-Headed Coneflower[c]	Rudbekia laciniata	FACW	X	X	
Wetland Sedges[d]	Carex spp.	UPL-OBL	X	X	
Switch Grass[d]	Panicium virgatum	FAC	X	X	
Wool Grass[d]	Scirpus cypernius	OBL	X		
Prairie Cord Grass[d]	Spartina pectinata	FACW	X	X	
Seed Oats[e]	Avena sativa	NO	X	X	
Annual Rye[e]	Lolium multiflorum	NO	X	X	
American Slough Grass[e]	Beckmannia syzigachne	OBL	X	X	

[a] Trees
[b] Shrubs
[c] Wildflowers
[d] Native grasses and sedges
[e] Temporary grasses

Wetland Indicator Status[1]:
OBL = Obligate wetland: occur almost always (>99%) under natural conditions in wetlands
FACW = Facultative wetland; usually occur in wetlands (67-99%)
FAC = Facultative; equally likely to occur in wetlands or in non-wetlands (34-66%)
FACU – Facultative; usually occur in non-wetlands (67-99%), but occasionally found in wetlands (1-33%)
UPL = Obligate Upland; occur in wetlands in another region, but occur almost always under natural conditions in non-wetlands
NO indicates there is no indicator status for the species

References:
[1] 1996 National List of Vascular Plants that Occur in Wetlands. United States Fish and Wildlife Service

Coir logs will be utilized in areas where significant erosion could occur at the toe of the slope on the east and west banks of Portage Creek. The coir rolls may be placed along the stream bank as designed. The adjacent ends of coir rolls will be tied together with coir twines. The extra loops of coir twine can be placed through the outer netting of adjacent coir rolls. Wooden wedges (approximately 48 inch) will be placed every 3 feet on the waterside. In the event the stream bank does not support the coir rolls, wooden wedges will be placed on the land side and the water side of the coir logs. The ends of the first and last coir roll will be dug into the bank.

Some soil erosion controls (i.e., mulch blanket) will be left in place until permanent vegetation is established at the Site and approved by EPA. EQ will monitor the progress of re-vegetation for a period of 1 year from final restoration planting and/or until re-vegetation acceptance by EPA. During this period, EQ will arrange for replanting as needed. Monitoring and maintenance activities will be performed in conjunction with monitoring and maintenance of Site erosion controls. EQ will utilize an inspection log to document monitoring observations as well as corrective action requirements and to document work completion. An example inspection log is located in Appendix E, and an example corrective actions log is presented in Appendix F.

3.3 SA7 Soil Erosion and Sedimentation Controls

Figure 3-3 presents the soil erosion and sedimentation control measures to be used during excavation activities in Portage Creek segment SA7. Portage Creek segment SA7 is divided into grid boundaries SA7-1 through SA7-5. The SA7 excavation area is within a floodplain located in a wooded area west of Portage Creek. The floodplain area is bordered by Reed Avenue to the south, Stockbridge Avenue to the north, Portage Creek to the east, and railroad tracks to the west. The overall surface area of the excavation is anticipated to be approximately 1,239 square yards. The approximate overall dimensions are 255 ft long by 50 ft wide. To allow for segregation of material types, the TSCA soils, located in segments SA7-1 through SA7-4, will be removed first, and the Subtitle D material (SA7-5) will be removed last. Removed materials will not be staged at the John Street TCRA support area; rather, they will be stabilized at SA7 and transported off site directly to appropriate approved landfills.

Prior to excavation activities, clearing and grubbing of vegetation will begin from an access location on Reed Avenue and proceed back to the excavated area, thereby clearing the construction access path and the excavation support area. Clearing and grubbing will take place in a manner that will protect root masses, and tree trunks will be cut to ground level only in order to maintain soil stability. Soil erosion and sedimentation controls will be installed after clearing and grubbing and prior to excavation activities. The following measures will be employed.

3.3.1 Construction Exit and Access Path

A 15-ft-wide by 75-ft-long construction exit of 2 to 3 inches of gravel extending from the curb line at Reed Avenue and extending 75 feet north, where it will transition into the access path, will be constructed on the vacant lot used to access the SA7 Removal Area. The construction entrance will be constructed from Reed Avenue north to allow disposal transport trucks to be backed off Reed Avenue for loading from a transfer station constructed at the transition from the vacant lot to the forested wetland. A 15-ft-wide access path will extend from the transfer station back to the SA7 excavation area. Details concerning construction and operation of the construction entrance, transfer station, and access path are provided in EQ's Technical Memorandum for SA7 Contaminated Soil Removal Operations. If necessary, the construction entrance will be constructed of 8-ounce nonwoven geotextile fabric underlayment with an 8-inch layer of stone cover. The construction entrance may require partial removal of the concrete curb on the north side of Reed Avenue to allow trucks to back onto the construction exit pad. The construction exit pad may be widened at the transition from Reed Avenue to the construction exit to create an approach apron to accommodate for the turning radius of off-site transport trucks. Any changes to the concrete curb will be restored subsequent to completion of removal operations. A pad of gravel will be installed over filter cloth where construction traffic leaves the wetland. As the construction vehicles drive over the pad, the pad will remove mud and sediment from the wheels and reduce soil transport off the site. The filter cloth separates the gravel from the soil below, keeping the gravel from being ground into the soil. The fabric also reduces the amount of rutting caused by vehicle tires. It spreads the vehicle's weight over a soil area larger than the tire width.

The construction exit will transition into a 15-ft-wide access path extending back from the Reed Avenue construction exit to the excavation area to allow crawler carriers and workers to enter and leave SA7. The access path will extend back to the excavation along the straightest route possible. However, the path will be cleared in such a manner to meander around mature trees targeted for preservation. The path will completely or partially encircle the excavation area to facilitate loading of the crawler carriers with an excavator from the perimeter of the SA7 excavation area. This is done to prevent the crawler carriers from entering into the excavation area for loading and to control the spread of contaminated soils on tracks of crawler carriers.

The Site Manager or designated alternate will use marking paint, survey tape, or flags to establish the access path location and extent of clearing and grubbing. The access path areas will be cleared of vegetation so that they are sufficiently clear enough for track vehicles to navigate safely and efficiently. Trees, stumps, roots, brush, and other vegetation in areas to be cleared will be cut off flush with or below the original ground surface, except for such trees and vegetation as may be indicated or directed by the engineer to be left standing. Trees designated to be left standing within the cleared areas will be trimmed of dead branches 1 ½ inches or more in diameter and will be trimmed of all branches at the heights indicated or directed. Limbs and branches to be trimmed will be neatly cut above the collar. Cuts more than 1 ½ inches will be painted with an approved tree-wound paint. Work areas will be clearly marked with temporary fencing, caution tape, and signage. Clearing should be accomplished by hand within 5 feet of trees and vegetation to be left standing. Clearing may also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct work. Trees, stumps, and stubs to be cleared, except where clearing is done by uprooting with machinery, should be cleared as close to ground surface as possible but not more than 6 inches above ground for small trees and 12 inches for larger trees. Depressions made by grubbing will be filled with approved fill material and compacted to make the surface conform to the original adjacent surface of the ground. Materials removed during clearing and grubbing activities will either be reused on Site or disposed of off site in a licensed disposal facility. Materials may also be shredded or chipped prior to re-use or disposal.

Disposal transport vehicles will enter the Site at the construction entrance/exit located on Reed Avenue. Trucks will progress to the transfer station for loading. The transfer station will be

constructed of high-density polyethylene road mats with timber swamp mat barrier walls that will provide a sturdy and stable area for load-out activities. Stone approach ramps will be placed on the north and south sides of the transfer station. The north ramp will facilitate crawler carriers to dump into the transfer station. The south ramp will serve as an elevated work bench for the excavator to be positioned on for loading of off-site disposal vehicles. Trucks will be loaded using excavators, and truck beds will be covered with tarps immediately after loading. After being loaded, the trucks will proceed south to the truck tire wash station and construction exit. Trucks carrying excavated materials will proceed directly to the appropriate landfill for the type of material they contain. Material will not be staged on site at excavation area SA7.

The existing roadways surrounding the Site will be inspected daily to ensure sediment is not tracked off site. Material tracked onto paved public roads will be removed on a daily basis and will not be swept into roadside ditches. In the event site material is identified on the public roadways, EQ will immediately implement corrective actions. Small amounts of sediment will be swept up via brooms and dustpans. Street sweeping may be performed if necessary.

3.3.2 Truck Tire Wash Station

A truck tire wash station will be constructed at the entrance to the construction access road on the vacant property on Reed Avenue. The truck tire wash will consist of a large metal pan with a grate. The construction trucks will pull up onto the grate, and truck tires will be pressure washed prior to leaving the site. Water that gravity drains from the truck tire wash will be pumped out of the pan into a temporary holding tank, vacuum trucks, or tanker trucks and the transported to the on-site wastewater treatment plant for treatment located at the John Street TCRA support area. The truck tire wash will help to prevent material being transported from the project site and onto public roadways.

3.3.3 Silt Fence

A silt fence will be installed at SA7 to control sheet flow from exposed earthen areas. The silt fence will be placed 1 to 2 feet inside the perimeter of the construction fence. A small trencher will be used to properly excavate a 6-inch-deep trench for burial of the silt fence anchor apron. A silt fence will also be installed around the perimeter of the staging pads. The specifications,

installation procedures, and inspection procedures will comply with State of Michigan's Department of Management and Budget's Soil Erosion and Sedimentation Control Guidebook, provided in Appendix C, Exhibit 8a. EQ will utilize a small trencher to excavate a 12-inch-deep trench for burial of the silt fence anchor apron. The silt fence utilized adjacent to the access roads and staging areas will be removed, once vegetation is well established and the up-slope area is fully stabilized.

3.3.4 Excavation Area Isolation Fence

EQ will install an orange construction fence at the limits of the overall clearing and grubbing area to restrict access. The fence will be set back 10 feet from the perimeter of the excavation area. A 50-ft-long opening will be left for load-out at the contact area with an access path turnaround.

The excavation area isolation fence will be used to clearly differentiate contaminated areas from non-contaminated areas. Steel fence posts will be driven every 10 feet to anchor the fence fabric to the posts with plastic zip ties. "Keep Out" and "Authorized Entry Only" signage will be affixed to the outside of the fence at 50-ft intervals.

3.3.5 Perimeter Construction Fence

An orange construction fence will be installed at the limits of the overall clearing and grubbing area to restrict access to the project site. Steel fence posts will be driven every 10 feet to anchor the fence fabric with plastic zip ties. Signage will be affixed to the outside fence at 50-ft intervals. The perimeter construction fence will be regularly checked for breaks and security.

3.3.6 Decontamination Area

A decontamination area will be set up adjacent to the excavation hot zone for personnel entry and exit and decontamination. A tent, table, chairs, trash receptacles, first-aid kit, emergency equipment, personal protective equipment, and spill kit supplies will be stored in this location. Any person or piece of equipment leaving the hot zone must move through the decontamination zone to remove contaminated clothing and to clean contaminated equipment.

Personnel will enter the hot zone in this location with the proper personnel protective equipment (PPE), and will exit through this location removing their PPE before entering the clean environment.

3.3.7 Stabilization and Restoration

The SA7 restoration activities are presented in Figure 3-4. Restoration activities will include removing support infrastructure, filling the excavated area with a sand/gravel mix, and adding top soil to reestablish vegetation. In addition, EQ will restore any street curb sections removed to facilitate truck access onto the vacant lot along Reed Avenue. Backfill source materials will be tested prior to site delivery in accordance with applicable regulations. Seeding and revegetation activities will occur in the disturbed areas as described below. The State of Michigan's Department of Management and Budget's Soil Erosion and Sedimentation Control Guidebook will be used as guidance for grading and shaping, seeding, and mulching activities.

EQ will conduct restoration activities at the Site as work progresses. For example, EQ will restore disturbed areas once activities in a particular work area are completed. The disturbed areas will generally be seeded with a temporary seed (winter rye) and mulched following completion of work activities and removal of the associated infrastructure within the area. The temporary seed will stabilize the disturbed area and act to control any potential erosion. The temporary seed will generally be applied at a rate of 1 to 3 pounds per 1,000 square feet. Permanent seed may not be applied to the site until the spring season to ensure the seed becomes well established in the disturbed areas. Therefore, during the spring, the areas containing the temporary seed will be slightly tilled, if necessary, and replanted with the permanent seed. The permanent seed will be applied at a rate of approximately 12 pounds per acre. Depending on the timing of the restoration activities, however, the permanent seeding may be performed during the current construction year in certain areas. Permanent seeding will only be performed during periods where acceptable growth could be expected. An annual rye grass, wheat, and/or winter barley will also be applied during application of the permanent seed at a rate of approximately 30 pounds per acre. These grasses will provide a temporary cover during development of the permanent seed. Seeding must take place within 5 days of establishment of final grade.

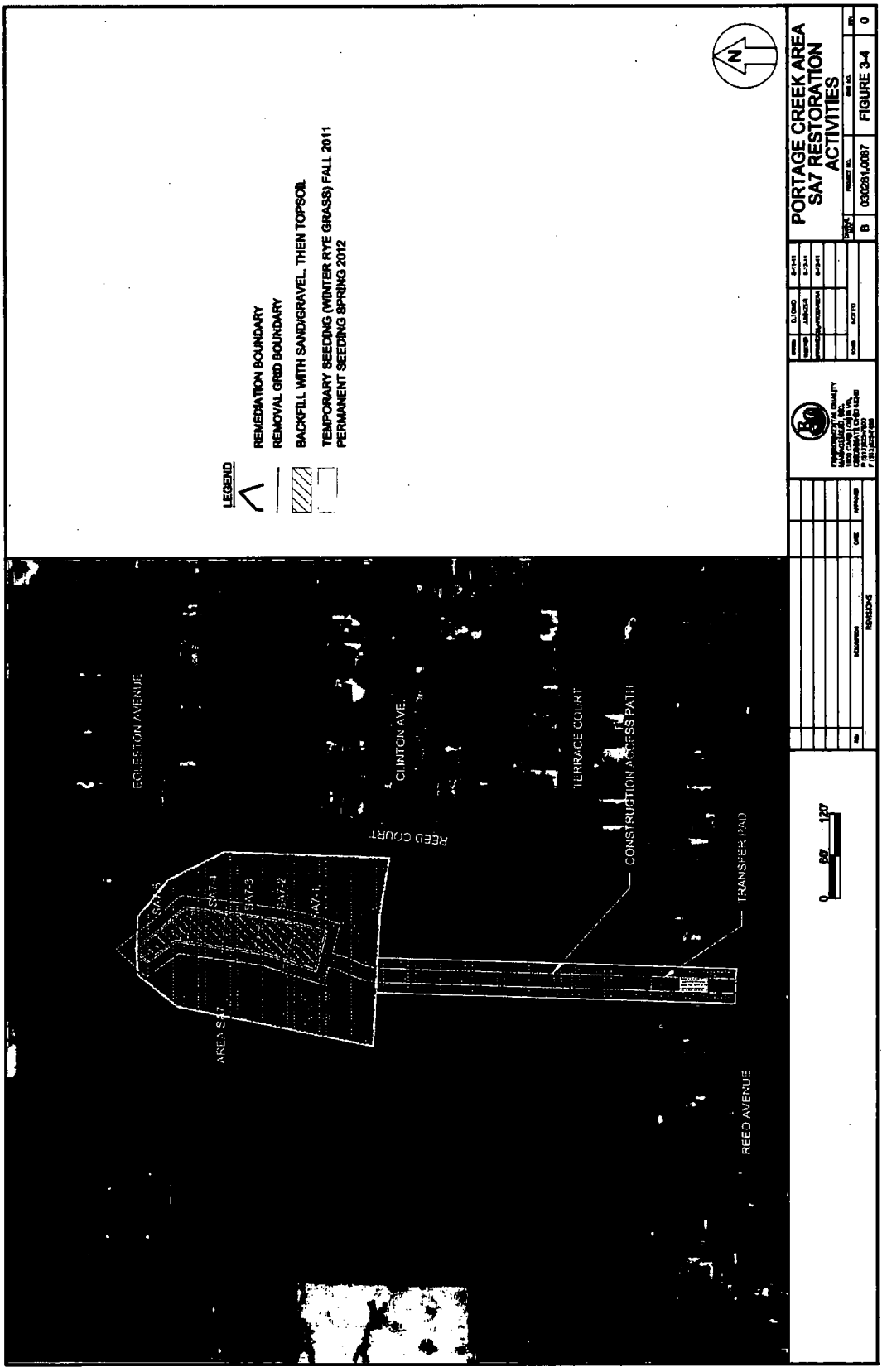


Figure 3-4. SA7 Restoration Activities

Plants (i.e., mix of herbaceous plants and shrubs) will be planted in certain areas. Planting will be performed by personnel familiar with accepted landscape planting procedures. Oversight personnel will inspect and approve seed mixes before they are applied in order to verify that they are transported in appropriate containers and are labeled with the ratios of the included species, total weight, date of preparation, and source. Oversight personnel will also inspect woody plant materials to verify the correct species and check for insects, diseases, appropriate root development, and/or indicators of excessive stress. Plants that do not appear healthy or of adequate quality for planting will be rejected and replaced with better quality stock. Seeding and woody planting methodologies will be implemented to verify that the materials are handled and installed appropriately.

Floodplain forests that extend throughout the Portage Creek SA7 floodplain will be revegetated by seeding and planting woody trees and shrubs. This habitat will be prepared for revegetation through the creation of micro-topography (i.e., the soil surface will not be evenly graded but would have a hummock and hollow topography), which will increase the diversity of soil moisture conditions typically found in natural riparian areas. Shade-tolerant wetland herbaceous plant species will be included in the seed mix for the floodplain forest habitat to provide ground cover after canopy development. Native trees and shrubs of the species observed in this habitat, as well as other species that typically inhabit and are adapted to periodic inundation, will be planted to a target density based on densities observed in tree plots surveyed during habitat characterization efforts. Tree and shrub stock will consist of container stock and/or root-balled trees that will be planted, supported, and protected from herbivory during the monitoring period.

The types of species ultimately selected will depend on availability and input from all appropriate interested parties such as federal, state, and local officials as well as the property owner. Planting will be performed when weather and soil conditions are suitable in accordance with industry practices. Plants will not be planted in areas unsuitable for proper growth. Table 3-1 in Section 3.2 lists potential flora species that will be used for revegetation. Tables 3-2, 3-3, and 3-4 in Section 3-2 present planting schedules for herbaceous plants, shrubs, and saplings for emergent wetland, forested wetland, and forested upland habitats, respectively.

Table 3-2. Emergent Wetlands Revegetation Planting Schedule

Species	Plant Type	Height	Number to be Planted	Density	Spacing	Comments
Herbaceous – See Table 3-1	Seed	N/A	N/A	30 lbs/acre	Random	Broadcast or hydroseeded

Table 3-3. Forested Wetlands Revegetation Planting Schedule

Species	Plant Type	Height	Number to be Planted	Density	Spacing	Comments
Herbaceous: See Table 3-1	Seed	N/A	N/A	30 lbs/acre	Random	Broadcast or hydroseeded
Shrubs:	1-Gallon container	>18 in.	Location-specific-based on area	TBD by EQM ecological consultant	Clumps of 2-3 same species, randomly distributed at least 5 ft apart	Even distribution among species
Alnus incana						
Cephalanthus occidentalis	1-Gallon container	>18 in.				
Cornus amomum	1-Gallon container	>18 in.				
Saplings:	5-Gallon container or root-balled	>48 in; >1 in diameter	Location-specific-based on area	TBD by EQM ecological consultant	Clumps of 2-3 same species; randomly distributed at least 10-ft apart	Even distribution among species
Betula nigra						
Quercus bicolor	5-Gallon container or root-balled	>48 in.; >1 in. diameter				
Platanus occidentalis	5-Gallon container or root-balled	>48 in.; >1 in. diameter				
Quercus palustris	5-Gallon container or root-balled	>48 in.; >1 in. diameter				

Table 3-4. Forested Uplands Revegetation Planting Schedule

Species	Plant Type	Height	Number to be Planted	Density	Spacing	Comments
Herbaceous: See Table 3-1	Seed	N/A	N/A	30 lbs/acre	Random	Broadcast or hydroseeded
Shrubs:	1-gallon container	>18 in	Location-specific-based on area	TBD by EQM ecological consultant	Clumps of 3 same species; randomly distributed at least 5-ft apart	Even distribution among species
Aronia melancarpa						
Cornus alternifolia						
Cornus racemosa						
Lindera benzoin						
Saplings:	5-Gallon container or root-balled	>48 in.; >1 in. diameter	Location-specific-based on area	TBD by EQM ecological consultant	Clumps of 3 same species; at least 10 ft apart	Even distribution among species
Quercus rubra						
Cercis Canadensis						
Juglans nigra						
Ulmus americana						

Some soil erosion controls (i.e., silt fence) will be left in place until permanent vegetation is established at the Site and approved by EPA. EQ will monitor the progress of re-vegetation for a period of 1 year from final restoration planting and/or until re-vegetation acceptance by EPA. During this period, EQ will arrange for replanting as needed. Monitoring and maintenance activities will be performed in conjunction with monitoring and maintenance of site erosion controls. EQ will utilize an inspection log to document monitoring observations as well as corrective action requirements and to document work completion. An example inspection log is presented in Appendix E, and an example corrective actions log is presented in Appendix F.

4. OTHER BMPS AND SITE CONTROLS

4.1 TCRA Support Area, Material Handling, and Staging Areas

Materials that may potentially be used or stored on Site are presented below. Procedures will be implemented to minimize the potential for release of these materials into the environment. In addition, procedures to be followed in the event of a material release are presented in Section 5. All permanent and temporary pollution controls and devices will be maintained throughout the life of the contract, or for the length of time construction activities create the particular pollutant.

4.1.1 Command Post

A command post and operations support area will be established at the property located at the intersection of East Crosstown Parkway and John Street. This area will be referred as the John Street TCRA Support Area. EQ will provide three office trailers for management and support Site operations. The TCRA Support Area will be approximately 2.1 acres in size and will border Portage Creek along the west side of the creek. The support area will include a waste staging/dewatering pad with pug mill, waste water treatment plant, inter/intra site access roads, truck tire wash facility, fuel tank, and equipment/material storage laydown areas. Two 8-ft by 40-ft connex storage containers will be set up for storage of small operations equipment, tools, construction materials, and protective equipment/supplies. EQ will provide sanitation, rubbish disposal, equipment storage containers, and water service in addition to providing electric, phone, and internet utilities.

EQ will construct a dewatering/material handling/staging pad that will be used for dewatering, sediment stabilization, and load out for most of the targeted removal areas on the Portage Creek Area Site. The approximate overall dimensions of the pad will be 130 ft by 250 ft. The sediment dewatering pad is discussed in detail in Section 4.1.3.

The wastewater treatment plant will also be located at the John Street TCRA Support Area. The wastewater treatment plant is discussed in detail in Section 4.2.

One storm water catch basin is located in the center section and one storm water catch basin is located in the northeast section of the John Street TCRA Support Area. These catch basins will be protected during construction activities and until vegetation is well established in the area in order to prevent sediment from entering the storm water collection system. The catch basins will be protected by using a geotextile inlet protection device (permeable fabric inserted around inlet). The geotextile inlet protection device is recommended where inlets drain sheet flow from gentle slopes.

EQ will create additional gravel covered parking/equipment/material laydown areas, a fuel storage tank and fueling area, and decontamination pads. Various support materials will be stored at the John Street TCRA Support Area for use on removal areas at a later date. Some of the materials that will be stored at the John Street TCRA Support Area include supersacks of Calciment® used for solidification, sand and gravel, silt fencing and silt curtain to be used as replacement if needed, coir logs, and planting materials. A silt fence will be installed around any material staging areas that store materials that could migrate off site in storm water. In addition, the materials located within the staging areas will be covered in the event dust issues arise and to prevent storm water from carrying the sand and gravel away from the storage pile. The command post area will be revegetated and stabilized in the same manner as described for SA6 and SA7.

Perimeter chain link fencing and access gates will be installed to enclose the TCRA Support Area. Fencing materials remaining from the owner of the property will be utilized at the TCRA Support Area. A fencing contractor will be procured to install the perimeter fence and supplement remaining fence construction materials. The perimeter fence will have two 16-ft-wide access gates along the west fence line for semi-truck access onto and off site for movement of material waste. A passage gate will also be installed along the west perimeter fence for personnel and visitor access to command post trailers. A third 16-ft-wide truck access gate will be installed along the east perimeter fence line to allow off-road truck and heavy equipment egress to/from Portage/Axtell Creek Area(s) for sediment removal operations.

EQ will provide site security to monitor the command post and support area during site non-working hours. A small office trailer will be provided to house a security officer at the entrance to the command post/support compound.

4.1.2 Waste Management

Waste, effluents, trash, garbage, oil, grease, and chemicals, etc., will not be disposed of in areas adjacent to Portage Creek or in areas not authorized for waste disposal. In the event waste material is dumped in an unauthorized area, the material will be removed, and the area will be restored to the undisturbed condition. If necessary, ground that becomes contaminated through fault or negligence will be excavated, disposed of as directed by the FOSC or designated government representative, and replaced with suitable fill material; it will then be compacted and finished with topsoil and planted as required to re-establish vegetation. Waste, trash, and other materials will be disposed of in accordance with all applicable federal, state, and local laws.

Contaminated debris, including personal protective equipment (PPE), will be collected, stored in designated containers, and transported off site, as necessary. Office trash will be placed in a dedicated dumpster and emptied on a regular schedule. The sanitary waste (Port-O-Lets) at the work area will be removed by a contractor on an as-needed basis.

Discarded materials other than those that can be included in the solid waste category will be handled as directed by the FOSC or designated government representative.

4.1.3 Dredged Sediment Handling and Dewatering

Areas within Portage Creek to be excavated will be isolated and dewatered to minimize the amount of water handled. Minimizing the amount of water to be handled will reduce the possibility of releasing contaminants back into the environment. EQ will isolate the removal areas within Portage Creek by using sheet piling to cofferdam the individual removal areas from up and downstream. Water flowing in the creek will be pumped and rerouted around the excavation areas to downstream locations. Any groundwater that collects in the excavation area will be pumped to the on-site wastewater treatment plant.

EQ will construct a SDR 17 10-inch solid wall HDPE pipeline from the on-site wastewater treatment plant located at the TCRA Support Area south to the south end of SA6 at the Stockbridge Avenue bridge. The pipeline will be temporary and will be removed at the completion of the project. The pipeline will transfer water collected within the excavated areas and water gravity drained from the excavated sediment to the wastewater treatment plant.

EQ will construct a dewatering/material transfer station on the north end of the construction entrances that will be used for dewatering, sediment stabilization, and load-out for most of the targeted removal areas on the Portage Creek Site. This will facilitate the transfer of contaminated soil hauled from the excavation area by crawler carriers to load out into over-the-road dump trucks. EQ will construct the station by installing six HDPE road mats as a base with timber mat side walls set along the outer edges. This will require the following steps for completion:

The pad will be constructed to facilitate the following operations:

- Allow for receipt of partially solidified sediment waste from over-the-road dump trucks from such areas as, but not limited to, the SA6 removal area for final dewatering/solidification and staging prior to shipment off site for final disposition.
- Allow for receipt of partially solidified sediment waste from off-road dump trucks from such areas as, but not limited to the SA5/Axtell Creek removal area(s) for final dewatering/solidification and staging prior to shipment off site for final disposition.
- Allow for dewatering of sediments staged on the pad with recovery of latent water in a collection reservoir built within the confinement of the pad to allow collection of water for processing through the adjacently located water treatment system.
- Allow for a tire wash station to be located on the pad to facilitate truck tire cleaning for over-the-road dump trucks dumping on/or loading out material on the pad.
- Allow for controlled application of solidification material to stabilize/dry sediments for over-the-road transport to final disposal facility.

The approximate dimensions of the pad will be 135 ft by 230 ft. The pad will consist of 3-ft-tall perimeter berm, HDPE/geotextile under-liner, leachate collection reservoir, sand under the drain layer, HDPE Geocell/rock cover layer, and a semi-truck tire wash station. Once the pad is constructed, a pug mill will be placed on the pad for solidification processing of wet sediment. To meet the facilitation requirements of the pad, it will be constructed with the following features:

- A collection reservoir will be excavated in the northeast corner of the pad area with a storage capacity of 20,000-30,000 gallons.
- The overall pad area will be graded to facilitate drainage to the collection reservoir area.
- A 3-ft-tall perimeter berm will be constructed with 1/3 slopes along the north, south, and west sides with the exception of where over-the-road trucks will enter and exit the pad along the western end. The berm slopes in these locations will be on a 1/10 slope to allow safe truck egress/exit from the pad. The slope along a portion the eastern side will also be constructed with a 1/10 slope to allow for safe access by off-road dump trucks to dump onto the pad.
- A 2-ft-deep by 2-ft-wide anchor trench will be excavated outside the perimeter berm to anchor geotextile underlayment and HDPE liner.
- An 8-ounce non-woven geotextile underlayment will be installed over the surface of the pad/reservoir area and the perimeter berm to be anchored in the trench located outside the perimeter berm.
- EQ will install a 1-ft-thick sand layer over the expanse of the pad area with exception of the reservoir area to serve as an underdrain for the pad to allow latent water released from staged sediments to accumulate in the collection reservoir.
- EQ will install an 8-inch layer of 2 to 3 inch stone in an 8-inch geocell over the sand layer to provide a final working surface for the staging pad.
- EQ will provide an automated truck wash system to be installed in the northwest corner of the staging pad to allow tire decontamination for over-the-road trucks exiting the pad subsequent to dumping/loading before entering clean work zones and public roadways. Details concerning design and installation are TBD. Wash water from tire washing will be allowed to drain onto the pad for collection in the reservoir via the sand layer under the drain.
- EQ will set up a pug mill on the staging pad at a location TBD, and a horizontal silo for housing solidification media adjacent to the pad.

EQ will install a pipeline from the on-site wastewater treatment plant located at the command post to areas within Portage Creek. The pipeline will be temporary and will be removed at the completion of the project. The pipeline will transfer water collected within the excavated areas and water gravity drained from the excavated sediment to the wastewater treatment plant. The only exception is wastewater generated at the SA7 truck tire wash will be pumped out of the truck tire wash and into vacuum trucks or tanker trucks which will transport the wastewater to the wastewater treatment plant at the John Street TCRA Support Area.

A 130-ft by 250-ft dewatering pad will be installed at the John Street Support Area to allow for additional dewatering of the dredged sediment. Trucks will unload wet dredged sediment onto the staging pad for dewatering and load dry dredged sediment from the staging pad for

transportation and off-site disposal. The staging pad will consist of an earthen berm covered with a geotextile membrane. The geotextile membrane will be covered with a 40 Mil HDPE liner, a layer of sand, and a layer of rock that is placed in an 8-inch thick HDPE geoweb. A geoweb material will be placed over the sand layer and filled with rock to create the working surface. The sediment will be placed on the porous working surface, which will allow water to gravity drain from the sediment into the sand layer. The staging pad will be sloped to one side to create a low spot for the collection of water. The water allowed to gravity drain from the sediment will be transferred to the on-site wastewater treatment plant for treatment and eventual discharge to Portage Creek. An additional solidification agent may be added to the sediment to prepare material for off-site transport. A pug mill with a stabilization feed silo will be used to introduce the stabilization agent to the sediment and blend material. Use of the pug mill will mitigate dust releases resultant from the solidification procedure. The stabilized sediment will be loaded onto trucks for landfill disposal, following a sufficient period of time to allow for drying. The sediment will only be transported off site after if passes a paint filter test to ensure the material is sufficiently dry. Therefore, the dredged sediment will be controlled during excavation, storage, and transportation activities in order to prevent a potential release into the environment.

4.1.4 Fuel Storage

Diesel fuel will be stored on site at SA6, and at the John Street TCRA Support Area. The diesel fuel will be contained within a stationary double-wall tank in a cordoned-off area away from road and construction vehicle traffic patterns. Traffic cones, signage, and construction fencing will be implemented to alert personnel to the location of the diesel fuel storage tank. A spill kit with absorbent booms and other cleanup materials as well as fire extinguishers will be stationed by the fuel tank at each location.

4.2 Wastewater Treatment Plant

A waste water treatment plant (WWTP) to support dredging operations will be constructed at the command post. The WWTP may be moved to a secondary location during subsequent

construction years as the project progresses. The WWTP will receive contaminated water from four different operation related sources:

- Water generated during dewatering of the isolated excavation areas.
- Water generated from dewatering sediments (groundwater) within the excavation areas.
- Water generated from dewatering excavated sediments staged on dewatering pad.
- Water generated from truck tire wash and equipment decontamination at the excavation area and dewatering/staging/load-out pad.

The WWTP system will be designed to remove total suspended solids (TSS), PCBs, iron, and manganese from collected water to suitable levels for discharge back into Portage Creek under an SRD agreement. Details concerning system construction and operation will be provided in a separate submittal entitled "Water Management Plan."

4.3 Dust Control Measures

Dust control measures will be a high priority for on-site personnel. To minimize the off-site migration of airborne dust, construction activities will include aggressive dust control measures to minimize the potential for the dispersion of air contaminants.

When necessary, dust control will be achieved primarily by watering down work areas and vehicle traffic routes, when necessary. Watering will be provided on an as-needed basis, as follows:

- During mixing operations
- During stockpiling and/or loading of material for transport
- Covering inactive stockpiles
- To wash down sidewalks, truck route, or vehicles (if necessary) impacted by soil handling and transportation activities (these areas may be swept if it can be accomplished without generating dust)
- To wet down truck loads to prevent any visible emissions during transport.

In the event fugitive dust from roadways requires control, water will be applied from a water truck equipped with a dispensing manifold. The water will be applied to roadbeds at the minimum rate necessary to control the dust, but not so as to create water erosion channeling. If the water application proves ineffective, a dust suppressant may be applied.

Additional dust control measures will be aggressively implemented under arid or windy conditions or whenever dust plumes are observed leaving the property. The following additional dust control measures may be used: increase frequency of water spray applications, regulate vehicle speed, place additional clean gravel as a ground cover in high dust-generation areas, apply dust suppressants, and/or use other appropriate measures. Care will be taken to avoid application of excessive amounts of water that may cause unacceptable working conditions or increase the possibility of surface run-off. If additional dust control measures do not eliminate visible dust, removal activities will be temporarily suspended until additional dust control measures have been implemented, or until adverse weather conditions abate. EQ will also use the specifications presented in the State of Michigan's Department of Management and Budget's Soil Erosion and Sedimentation Control Guidebook as guidance for dust control measures.

If the water application proves ineffective, EQ will be prepared to apply a dust suppressant. EQ will ensure that the chosen dust suppressant will not cause any environmental harm when used in accordance with application instructions. Additional dust control alternatives may be re-evaluated, on an as-needed basis, in consultation with the FOSC or designated government representative.

5. SPILL PREVENTION AND CONTROL PLAN

5.1 Potential Spill Sources and Discharge Prevention Measures

Potential sources of spills at the Site are presented in Table 2-1 in Section 2. For the purposes of this section, spills of oil and greases and nutrients will be considered.

Diesel fuel will be stored at the Site for the purpose of refueling excavation equipment.

A 500-gallon free-standing double-wall fuel tank will be used for vehicle refueling on site. The fuel tank will be located at the command post which will serve as a central fuel unloading location and may be relocated to excavation areas including SA6 or SA7 as needed. A spill kit will be positioned near the fuel tank for use in the event of a spill or leak while refueling operations are underway. Absorbents and other spill cleanup materials will be properly disposed of in labeled 55-gallons drums.

During the restoration phase of the project, nutrients and fertilizers may be used in order to enhance the growth of species planted to stabilize the stream banks. The fertilizers will be present at the Site only in small quantities and will be housed inside containers that are made of materials compatible with contents. A spill of this type could be cleaned up quite easily with absorbent pads or swept with a broom and dustpan. All recovered materials will be disposed of in accordance with manufacturer's specifications and applicable regulations.

5.2 Spill Response and Cleanup

Regardless of how well spill prevention procedures are implemented at a project site, emergency situations (e.g., spills, leaks) may still occur at the site. Therefore, contingency procedures are critical in minimizing the impact of these spills/leaks on human health and the environment. Spill response procedures are summarized in the following section.

In the event of a spill or leak, the Site Manager has the responsibility to ensure proper response and reporting procedures are followed. In the event of a spill, the person discovering the spill will take immediate action to stop the spill and protect/decontaminate affected personnel and immediately notify the Site Manager, if it is safe to do so. In the event an emergency occurs and the Site Manager is not on Site, the highest ranking worker on Site will serve in his/her place until he arrives. The Site Manager will determine the nature of the emergency and take appropriate actions.

In order to ensure that site personnel are able to provide immediate response to spills, contact information for the Site Manager will be provided to each employee and/or posted at each work area. Contact information for the Site Manager is presented below:

Site Manager: Eric Bowman
Cell Phone: (513) 265-8875

The Site Manager can also contact personnel on Site to aid in the spill response, if necessary. Only trained personnel should assist in spill response measures. Depending upon the nature and extent of a release, some of the following procedures may not apply in every situation. However, personnel will follow the procedures to the extent necessary to ensure personal safety, yet provide prompt control and containment of the release.

Immediate safety hazards associated with the release (i.e., fire, explosion, or vapor hazards) will be ascertained promptly. Any hazardous condition that presents a threat to the public and personnel safety will first be mitigated before personnel attempt to control or stop the release. Personnel on Site will adhere to the following procedures in the event of a spill or leak:

1. Attempt to contain and control the spill and protect/decontaminate personnel, if it is safe to do so.
2. Notify the Site Manager.
3. If unsafe conditions exist, personnel should evacuate the area.
4. After initial response measures have been taken or if the spill is beyond the individual's ability to contain it, make note of the time the spill occurred, the type of material spilled, and the approximate quantity of the spilled material on the Daily Activity Quality Control Report.
5. Only the Site Manager or his designated alternate shall have any official communication with non-employees, regulatory agencies, and/or the media.

The primary communication devices will be two-way radios (which operate at frequencies that do not interfere with local communication) and cell phones. Air horns may also be used to alert personnel of emergency situations. The primary communication with the appropriate agencies will be accomplished using cell phones and/or commercial telephone lines.

The Site Manager or designated alternate should adhere to the following procedures in the event of a spill or leak:

1. Mobilize on-site personnel as necessary to assist with spill response and contact the FOSC.
2. Contact the proper civil authorities if necessary (e.g., fire, police, etc.). Notify the proper agencies when there has been a reportable release of material(s) into the environment.
3. Be prepared to evacuate the entire Site at any time during the spill response.
4. Keep unnecessary people away, isolate hazardous areas, and deny entry.
5. Do not allow anyone to touch the spilled material and keep people upwind and out of low areas.
6. Keep combustibles, open flames, and other sources of ignition away from spilled oil.
7. Use water spray to reduce vapors, as needed.
8. Designate personnel to protect nearby outfalls and waterways with sorbent booms/socks to prevent the spill from exiting the site.
9. Use oil-absorbent booms to collect oil sheens on the water surface.
10. Designate personnel to contain the spill area using absorbent booms, socks, and/or pillows from on-site spill kits.
11. Once the spill has been contained, stabilize the spill (if necessary) prior to placing the spilled material into containers for disposal.
12. Containerize the materials from the spill. For small spills, use paper towels and/or sorbent towels to wipe up the spill, or apply absorbents to the spill area. For larger spills, a pump may be used to transfer the spillage into 55-gallon drums until absorbents, sorbent towels, or paper towels can be used to recover the remaining spillage. Once the free liquids have been removed, shovels, brooms, and dust pans may be used to clean up the absorbent materials and any impacted or discolored soil around the area of the spill. Place all of these materials into 55-gallon drums for characterization and future disposal/treatment.
13. Remove contaminated soils. Excavation will be restored to approximately original grade with clean fill material.
14. Re-usable equipment should be decontaminated and placed back into its proper storage area. The decontaminated equipment should be thoroughly inspected prior to storage.
15. Provide verbal and written reports of the spill, if required, to the appropriate authorities.
16. If the spill is beyond the site's response capabilities, contact additional resources as necessary.

17. Provide for the proper disposal/treatment of the wastes at off-site permitted waste management facilities, if necessary.
18. Corrective actions should only be performed by properly trained individuals.

An adequate supply of spill control equipment necessary to respond to certain spills will be maintained at the Site. Spill control equipment maintained at the site will include:

- Safety glasses
- Protective gloves
- Protective coveralls
- Shovels
- 55-gallon drums
- Solvent or other decontamination supplies
- Absorbent materials (e.g., sorbent pads)
- Oil booms

Personnel will be trained in spill response procedures and the use of all spill control equipment. Spill response materials will be located in storage containers at each work area. The materials will be available at all times. The materials will be compatible with the type of material being handled.

5.3 Spill Notification

Numerous regulations govern the notification and response of spills or releases at the Site. 40 CFR 302, Designation, Reportable Quantities and Notification, identifies substances considered hazardous along with specific reportable quantities for these substances. A reportable quantity (RQ) is a pre-established quantity of a specific chemical or material that, if released into the environment above the specified quantity, will require reporting to the proper agencies. Notification and reporting procedures are often dictated by whether or not a Reportable Quantity (RQ) of a substance has been released into the environment.

This section presents the notification and reporting procedures that will be followed by Site personnel in the event of a spill or release. Depending on the magnitude of the spill, and whether

or not the spill is contained, spill notification and reporting will require different courses of action.

If a spill requires notification to outside agencies (as described in Table 5-1), the Site Manager will gather the necessary information and notify the appropriate agencies. In addition to the following external notification procedures, the Site Manager will also immediately notify the FOSC or designated Government representative in the event of a spill. A listing of agencies/personnel that may need to be contacted is presented in Table 5-2.

- Name, address, and phone number of the person making the spill report.
- Name and phone number of the person to contact for further information.
- Location and source(s) of the release or discharge.
- Chemical name or identity of any substance(s) involved in the release or discharge.
- If the substance is extremely hazardous.
- Estimate of the quantity (gallons or pounds) discharged into the environment.
- Date, time, and duration of the release or discharge.
- Environmental medium or media into which the substance was released or discharged.
- Name and location of water damaged, if applicable.
- Identity of any response organization responding to the spill
- Potential health effects associated with the release or discharge of the substance.
- Precautions taken, including containment, evacuation, remediation, or other proposed response actions.
- Proposed cleanup procedures.

When a spill is reported to the appropriate agencies, they will quickly determine from the information provided what additional measures need to be taken to control the spill. Tables 5-1 and 5-2 present a summary of the spill notification procedures and contact phone numbers.

Table 5-1. Notification Requirements In Michigan [a]

Act & Regulation	Reporting Criteria	Initial Notification	Written Follow-up Report	Notes
SARA Title III Section 304 40 CFR 355.40 (EHS & Hazardous Substances)	Release of a hazardous substance (40 CFR 302, Table 302.4) or Extremely Hazardous Substance (EHS) (40 CFR 355, Appendix A) from a facility (including motor vehicles, rolling stock, and aircraft) in a quantity equal to or greater than its corresponding reportable quantity that migrates beyond the facility boundaries. Includes continuous release reportable under CERCLA Section 103. Excludes release that is federally permitted or that results in exposure to persons solely within the boundaries of the facility. See 67 FR 18899 (4/17/02) for guidance on the CERCLA federally permitted release definition for certain air emissions.	Immediate: to LEPC(s) of any area(s) potentially affected, and SERC (MDEQ PEAS line accepts notification on behalf of SERC) by owner or operator Continuous releases must be identified as such and are reported initially and when there is a significant change in the release. Transportation related releases can be reported to 911.	As soon as practicable after release: to LEPC(s) and SERC. For continuous releases: Initial written within 30 days after initial telephone notification & Follow-up within 30 days of first anniversary of initial written notification: to LEPC(s) and SERC Michigan SARA Title III Program accepts reports on behalf of the SERC.	PEAS: 800-292-4706 (from within MI) or 517-373-7660 (from outside MI). Contact your LEPC for phone number to report releases. For further information contact Michigan SARA Title III Program 517-373-8481
CERCLA Section 103 40 CFR 302 (Hazardous Substances)	Release into the environment of a hazardous substance (40 CFR 302, Table 302.4) or hazardous constituent in a mixture or solution (including hazardous waste streams) from a facility (including transport vehicles, vessels and aircraft) in a quantity equal to or greater than its corresponding reportable quantity in any 24-hour period. See 40 CFR 302.6 for notification requirements for radionuclide releases Includes continuous release: occurs without interruption or abatement or that is routine, anticipated, and intermittent and incidental to normal operations or treatment processes. Excludes release that is federally permitted. See 67 FR 18899 (4/17/02) for guidance on the CERCLA federally permitted release definition for certain air emissions.	Immediate: to NRC by person in charge of vessel or offshore or onshore facility. Continuous releases must be identified as such and are reported initially and when there is a significant change in the release. (Immediate means within 15 minutes of discovery.)	For continuous releases only: Initial written within 30 days after initial telephone notification & Follow-up within 30 days of first anniversary of initial written notification: to USEPA Region 5.	U.S. Coast Guard National Response Center (NRC) 800-424-8802 For further information contact Michigan SARA Title III Program 517-373-8481 or USEPA's RCRA, Superfund & EPCRA Call Center 800-424-9346
NREPA 1994 PA 451 Part 201, Environmental Remediation	Unpermitted release into the environment over a 24-hour period of a hazardous substance (*2001 version* of 40 CFR 302, Table 302.4) in a quantity equal to or greater than its corresponding reportable quantity.	Within 24 hours of discovery: to MDEQ-RRD district office (PEAS after hours) by owner, operator or person holding easement interest.	Upon request: to MDEQ-RRD district supervisor. Specific forms required for: "Notice Regarding Discarded or Abandoned Containers"	PEAS: 800-292-4706 (from within MI) or 517-373-7660 (from outside MI) MDA Agriculture Pollution Emergency Hotline: 800-405-0101

Table 5-1. (continued)

Act & Regulation	Reporting Criteria	Initial Notification	Written Follow-up Report	Notes
			(Form EQP4476)	(from within MI) or
	Does not include release solely from UST systems regulated under Part 213, and release solely from disposal area licensed under Part 115 and discovered through disposal area's hydrogeological monitoring plan. Release of substance regulated by MI Dept of Agriculture (MDA) (fertilizer, soil conditioner, or pesticide) excluding normal agricultural practices: *also* report to MDA. Revised rules effective 12/21/02.	Report agricultural release to MDA.	and "Notice of Migration of Contamination" (Form EQP4482).	517-373-0440 (from outside MI) For further information contact MDEQ-RRD
Fire Prevention Code 1941 PA 207 Part 2 of Storage and Handling of Flammable and Combustible Liquids rules (FL/CL code)	A release from an AST system of >55 gal of any flammable or (flash point <200°F) to the ground or within a secondary containment area during any 24-hour period. New FL/CL rules effective 8/13/03.	As soon as practicable after detection of release: to PEAS by owner or operator	Within 10 days after release: to MDEQ (WHMD, Storage Tank Unit) outlining cause, discovery, response to prevent recurrence.	PEAS: 800-292-4706 (from within MI) or 517-373-7660 (from outside MI) For further information: contact MDEQ-WHMD Storage Tank Unit
49 CFR 171 (Transportation of Hazardous Materials)	Initial verbal notice: Incident during transportation (including loading, unloading, temporary storage) involving (1) hazardous material and resulting in death, injury, property damage, evacuation, highway closure, or flight pattern alteration as specified; (2) fire, breakage, spillage, suspected contamination involving radioactive material or infectious substances; (3) marine pollutant exceeding 119 gal liquid or 882 lbs solid; (4) other per judgment of carrier (e.g., continuing danger to life exists at scene of incident).	As soon as practical: to NRC by carrier representative. For infectious substances, carrier may phone notice to U.S. Public Health Service instead of NRC.	Within 30 days of discovery: to US DOT on DOT Form F 5800.1 (Rev 6/89) "Hazardous Materials Incident Report." This form must be used for all incidents that occur on or before 12/31/04.	NRC 800-424-8802 U.S. Public Health Service 800-232-0124
	Hazardous material = hazardous substance (40 CFR 302, Table 302.4), hazardous waste (40 CFR 262), marine pollutant (49 CFR 172.101 Appendix B), elevated temperature material, listed on Hazardous Materials Table (49 CFR 172.101), or meets criteria for hazard class/division in 49 CFR 173. Written follow-up report: Required for all of above, plus		For incidents that occur on or after 1/1/05, use DOT Form F 5800.1 (01-2004).	For further information contact US DOT Hazardous Materials Information Center at 800-467-4922 or online at http://hazmat.dot.gov

Table 5-1. (continued)

Act & Regulation	Reporting Criteria	Initial Notification	Written Follow-up Report	Notes
	any unintentional release of hazardous materials from a package (including tank), or any quantity of hazardous waste discharged during transportation. This rule applies to all incidents up to and including 12/31/04. Criteria per new rule published 12/3/03 in 68 FR 67745 are effective 1/1/05 and will appear in next version of this table.			
NREPA 1994 PA 451 Part 31, Water Resources Protection (Release to surface of ground, surface water, groundwater or public sewer system)	Unpermitted release directly or indirectly to public sewer system, surface of ground, surface water or groundwater from an oil storage facility or on-land facility of a "polluting material" (oil, salt, or any material specified in table 1 in R 324.2009) in excess of its threshold reporting quantity during any 24-hour period. See Part 5 rules, effective 8/31/01, for details and exemptions. 1994 PA 451 amended by HB 5586 effective 6/15/04 added reporting requirements.	As soon as practicable after detection: to PEAS and 911 by owner, operator or manager. State agencies call 911 if release reported to them by another state or Canada	Within 10 days after release: to MDEQ-WD chief and to the local health department where the release occurred, outlining cause, discovery, response & prevention of recurrence.	PEAS: 800-292-4706 (from within MI) or 517-373-7660 (from outside MI) For further information contact MDEQ-WD
CWA Section 311 33 CFR 153 (Navigable waters – Coast CWA Guard/DOT) Control of Pollution by Oil and Hazardous Substances, Discharge Removal	Discharge of a harmful quantity of oil or a hazardous substance from a vessel or onshore or offshore facility into or upon navigable waters of the United States or adjoining shorelines.	Immediate: To NRC by person in charge of vessel or facility. If direct reporting to NRC not practicable, may report to district Coast Guard or USEPA predesignated On-Scene Coordinator (OSC).	Not required.	NRC 800-424-8802 District 9 Coast Guard 216-902-6117 USEPA Region 5 for 24 hour spill line 312-353-2318

Table 5-1. (continued)

Act & Regulation	Reporting Criteria	Initial Notification	Written Follow-up Report	Notes
	Harmful quantity = oil discharge that violates applicable water quality standards, or causes a film or sheen upon or discoloration of the surface of the water or adjoining shorelines, or causes a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines; or a hazardous substance (40 CFR 302, Table 302.4) in a quantity equal to or greater than its corresponding reportable quantity. Oil = oil of any kind or in any form including petroleum, crude oil, petroleum refined products, sludge, oil refuse, oil mixed with wastes, etc., as well as vegetable and animal oils.			For further information contact USEPA Region 5 24 hr spill line at 312-353-2318 or District 9 Coast Guard at 216-902-6054
CWA Section 311 40 CFR 110 (Discharge of Oil)	Discharges of oil that violate applicable water quality standards, or cause a film or sheen upon or discoloration of the surface of the water or adjoining shorelines, or cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines. Oil = oil of any kind or in any form including petroleum, crude oil, petroleum refined products, sludge, oil refuse, oil mixed with wastes, etc., as well as vegetable and animal oils.	Immediate: to NRC by person in charge of vessel or facility.	Not required.	NRC 800-424-8802 For further information contact MDEQ-WD
TSCA 40 CFR 761.125 (PCBs)	Spills of PCBs at concentrations of 50 ppm or more and subject to decontamination requirements under TSCA that: contaminate surface water, sewers, drinking water supplies, grazing lands or vegetable gardens, or exceed 10 lbs. (TSCA specifies that these requirements are in addition to any under CWA or CERCLA; e.g, CERCLA requires spills of 1 lb or more to be reported to NRC.)	As soon as possible after discovery, and within 24 hours: to USEPA Region 5.	Not required to be submitted. Records of cleanup and certification of decontamination shall be documented.	USEPA Region 5 Toxics Section 312-886-6003 For further information contact USEPA Region 5

NOTE: If the release is a THREAT TO HUMAN HEALTH OR SAFETY, call 911 or the fire department and the local State Police or the State Police Operations Division at (517) 336-6100.

[a]This table covers only those reporting requirements found in rules and regulations that apply in Michigan. Releases might be reportable under multiple regulations. Additional reporting requirements might be found in permits, licenses, registrations, contingency and pollution plans, and local ordinances.

Table 5-2. Agency Contact Information

Kalamazoo Co. Emergency Management (LEPC) 1500 Lamont St. Kalamazoo MI 49048 269-383-8712	National Response Center (NRC) 1-800-424-8802
Michigan Department of Environmental Quality (MDEQ) P.O. Box 30457 Lansing, Michigan 48909 1-800-292-4706 1-517-373-7660	U.S. EPA Region 5 Toxics Section 77 West Jackson Blvd. Chicago, IL 60604 1-312-886-6003
Kalamazoo Fire Department 150 E. Crosstown, Suite A Kalamazoo, MI 49001 911 269-337-8120	Sam Borries U.S. EPA 77 West Jackson Blvd. Chicago, IL 60604 1-312-353-8360 1-312-802-5336
Mike Alexander MDEQ, Constitution Hall 525 West Allegan St. 2nd Floor, South Tower Lansing, Michigan 48933 1-517-335-4189 (office)	U.S. EPA Region 5 24 hr Spill line Predesignated OSC 1-312-353-2318
Bronson Methodist Hospital 601 John Street Kalamazoo, MI 49007 269-341-7654	

5.4 Spill Reporting

In the event of a material release or spill above its RQ into the environment, the Site Manager or designated alternate must give verbal notification to the appropriate agencies listed in Table 5-1. EQ's site management will be prepared to relay as much of the following information that is known or can be estimated at the time of notification. (Please remember this is an initial report and estimates can be corrected in the follow-up emergency notice report.)

- Name, address, and phone number of the person making the spill report.
- Name and phone number of the person to contact for further information.
- Location and source(s) of the release or discharge.
- Chemical name or identity of any substance(s) involved in the release or discharge.
- If the substance is extremely hazardous.
- Estimate of the quantity (gallons or pounds) discharged into the environment.

- Date, time, and duration of the release or discharge.
- Environmental medium or media into which the substance was released or discharged.
- Name and location of water damaged, if applicable.
- Identity of any response organization responding to the spill
- Potential health effects associated with the release or discharge of the substance.
- Precautions taken, including containment, evacuation, remediation, or other proposed response actions.
- Proposed cleanup procedures.

After the release or discharge, written follow-up emergency reporting may be required. This follow-up emergency report is the company's opportunity to explain in its own words the circumstances and actions relating to the release of pollutants to the environment. Specific report forms may be required for certain spills as specified in Table 5-1. If no form is specified, the written emergency report should follow the questions sequence as indicated below. If any of the questions are not applicable to the incident, indicate N/A (not applicable) for that item. An example External Spill Report Form is presented in Appendix D.

1. When

a) Actual time, date, and duration of the discharge or release.

b) Actual time and date of discovery of the release or discharge.

c) Actions taken to respond to and contain the release or discharge.

d) Indicate the spill number assigned, if applicable. If this number is not known, call a duty officer during business hours and ask. If the National Response Center was notified, provide its assigned case number.

2. Location

a) Location of facility from which the release or discharge occurred.

b) Location of release: county, township, and city.

c) Longitude and latitude of the release, if known.

3. Product Release

a) Common and/or technical name(s) of the material(s) released or discharged and CAS number(s).

b) What was the quantity and duration of the discharge? Indicate volume(s) in gallons or pounds.

4. Environmental Impact

a) Name of the environmental medium or media affected (i.e., navigable waters, land, and/or air). If navigable waters, please identify.

b) What was the length of area of the navigable waterway affected?

c) What was the ground surface area (square ft or yards) and depth of soil contamination?

d) To the extent information is available, identify damage to wildlife and/or vegetation.

e) To the extent information is available, identify impact to human health and safety (i.e., evacuations, exposures, etc.).

f) Where appropriate, identify medical advice provided for exposed individuals and or local medical personnel.

5. Monitoring and Detection

a) If the release or discharge was monitored, indicate the method of detection and concentrations detected.

b) If the release was airborne, how was the wind direction and speed determined?

c) Was the public warned, and if so, how?

6. Mitigation, Containment Action

a) How much product or waste was recovered or neutralized?

b) How was the material recovered or neutralized?

c) Were any other actions taken to reduce the impact of the discharge (containment, adsorbents, on-Site treatment, etc.)?

7. Prevention Measures

Provide plans to prevent recurrence of the discharge or release that may occur at this specific source. This may include employee training, replacement of equipment, construction, or security measures such as lighting, fencing, or locks.

8. Health Risks

List known or anticipated acute and chronic health risks of exposure associated with the substance that was released.

9. Permit Numbers

a) Indicate any air, water, or other permit numbers that may be pertinent to this incident (voluntary information).

b) If this is an NPDES/air permit, enclose a copy of the current effluent/emission limitations.

10. Chronology

Provide a chronological review of the incident. Include a chronology of communications with state and local government.

11. Documentation

Provide any reports or any other documents that pertain to the incident (e.g., accident reports, manifest, bills of lading, laboratory analyses).

12. Causes

Describe any extenuating circumstances that caused the discharge.

13. Economic Impact (Information is voluntary)

a) Estimate the dollar value, if any, of the spilled product.

b) What was the equipment damage cost (estimate)?

c) What was the cost of spill cleanup (estimate)?

d) What are the estimated costs of spill prevention to eliminate reoccurrence of the event?

6. MAINTENANCE AND INSPECTIONS

6.1 Inspections and Monitoring

Throughout the construction period, EQ will inspect the Site daily to ensure soil erosion and sedimentation controls are operating properly. Locations where vehicles enter or exit the Site will also be inspected to determine evidence of off-site sediment tracking. If sediment escapes the Site, accumulations will be removed as soon as possible. Street sweeping will be conducted as necessary. Storage areas will be inspected to ensure that materials (solidification agents, etc.) are not migrating from the areas in which they are stored.

The soil erosion control measures will be under the specific supervision and control of a storm water operator who has been certified by MDEQ. The construction activity will also be inspected by a certified storm water operator once per week, and within 24 hours after every precipitation event that results in a discharge from the Site. The storm water operator will maintain a log of the inspections, which will be maintained for a period of 3 years from the date of the inspection. An example Inspection Report Form is located in Appendix E. EQ will also note any deficiencies on the Daily Activity Quality Control Report, which will be filed under separate cover. Any deficiencies will be immediately reported to the Site Manager and the FOSC or designated Government representative, and corrective actions will be implemented accordingly.

Closely associated with the inspections discussed above are periodic maintenance activities associated with the erosion control measures. The erosion control measures must be maintained in an effective operating condition. Problems noted during the inspection will often dictate required maintenance activities. If inspections determine that the erosion control measures are not operating effectively, maintenance will be performed before the next anticipated storm event, or as soon as practicable. Erosion controls that have been intentionally disabled, run-over, removed, or otherwise rendered ineffective will be replaced or corrected immediately. Table 6-1 lists the specific control measures and the common maintenance activities associated with each

control measure. Also provided in the table is the frequency of maintenance activities. The State of Michigan's Department of Management and Budget's Soil Erosion and Sedimentation Control Guidebook presented in Appendix C provides additional detailed information about each soil erosion and sedimentation control in use at the Site.

In addition to routine inspections conducted by the Site Manager or designee, all construction work for which a permit is required shall be subject to inspection by the City of Kalamazoo and all such construction work shall remain accessible and exposed for inspection purposes until approved by the City of Kalamazoo. The permit applicant shall:

- Allow the work to remain accessible and exposed for inspection purposes.
- Notify the City of Kalamazoo that construction work is ready for inspection.
- Request for inspection shall be made at least one working day before the inspection is desired.
- Request final inspection after all construction work is completed.
- Request a Certificate of Completion after all final inspections have been conducted and approved.

In addition to the required inspections specified above, the City of Kalamazoo may make or require other inspections to ascertain compliance with the Soil Erosion and Sedimentation Control Plan.

6.2 Corrective Actions

Due to the frequency and level of monitoring at the Site, acts of noncompliance with this plan will be immediately observed. The Site Manager will promptly address all acts of noncompliance through corrective actions and implement procedures to prevent a similar recurrence. The FOSC or designated Government representative will be notified of any noncompliance with the Soil Erosion and Sedimentation Control Plan. In addition, proposed corrective actions will be provided to the FOSC or designated Government representative. The Site Manager will maintain a log of corrective actions, which will be maintained for a period of 3 years from the date of the corrective action. An example Corrective Action Log is located in Appendix F.

Table 6-1. Common Maintenance Activities Associated with Erosion Control Practices

Practice Title	Common Maintenance Activity	Frequency of Maintenance
Access Roads and Construction Exit	• Add gravel.	As needed or when original stone becomes covered with mud.
	• Remove sediment from public roads.	As needed.
Silt Fence	• Remove deposited sediment.	If the fence is sagging or the soil has reached one half the height of the fabric.
	• Remove and reinstall fence.	If water is seeping under the fence.
	• Replace torn fabric or collapsed, crushed fence segment.	As needed.
	• Remove fence.	Once vegetation is well established and the up-slope area is fully stabilized.
Rock Discharge Pad	• Replace displaced stone and fabric.	As needed.
Coir Log	• Replace torn or damaged material.	As needed.
Seeding	• Re-seed areas lacking vegetative stands.	As needed.
	• Repair damage caused by erosion after storm events (replace seed, straw, mulch blanket, etc.).	After storm events.
Mulch Blankets	• Apply tacking materials or additional netting to hold mulch in place.	As needed.
Silt Curtain	• Replace torn or damaged material	As needed.
Truck Tire Wash Station	• Replenish with clean water	As needed.
Dust Control	• Check water level in water truck • Preventative maintenance	As needed

6.3 Post Construction (Habitat Restoration) Monitoring

Following completion of construction activities in each section of Portage Creek, post-construction best management practices will be monitored to ensure that they are preventing soil erosion and sedimentation from occurring. EQ will monitor the progress of revegetation for a period of 1 year from final restoration planting and/or until re-vegetation acceptance by EPA and associated stake holders. During this period, EQ will arrange for replanting as needed. Monitoring and maintenance activities will be performed in conjunction with monitoring and maintenance of site erosion controls. EQ will leave erosion control features such as the silt fence in place and monitor and maintain those features until final revegetation has been re-established and accepted by EPA. EQ will utilize an inspection log to document monitoring observations as well as corrective action requirements and document work completion. An example inspection log is located in Appendix E.

Bank stabilization and revegetation activities will be monitored to document progress toward the post-construction project objectives. Monitoring will include visual observations of the reconstructed banks and in-channel sediment conditions for signs of detrimental erosion, failure, and vegetation/seeding success.

Areas that are seeded/planted after excavation will be monitored frequently during the first growing season, and monitored once annually. Additional inspections may be performed following drought or flood conditions that could significantly affect planted vegetation. The monitoring inspections would be performed to evaluate the health and growth of planted vegetation and determine whether stressful environmental conditions (e.g., insect infestations, drought) are jeopardizing plant survival. Maintenance activities may be necessary to address observed deficiencies or damage. Restored areas will be adaptively managed by responding to the observed successes and failures of the vegetative communities and by focusing on enhancing species associations that are adapting favorably. Maintenance activities which may consist of reseeding of bare spots in ground cover, weed control, or replacement of non-surviving plants will be discussed with USEPA and MDNR prior to implementation.

Implementation of an exotic/invasive species control program is an essential part of a successful revegetation program. Species to be monitored include exotic/invasive species and other aggressive species with a tendency to develop into monocultures. Potentially problematic species in the project area include common cattail (*Typha latifolia)*, common reed (*Phragmites australis*), multiflora rose (*Rosa multiflora*), purple loosestrife (*Lythrum salicaria*), reed canary grass (*Genus species*), autumn olive (*Elaeagnus umbellata*), garlic mustard (*Alliaria petiolata*), and yellow iris (*Iris pseudacorus*). Exotic/invasive species may be controlled through the physical removal of specimens, or through the broadcast or spot spraying of glyphosate herbicide, such as Rodeo®. Initial exotic/invasive species will be controlled concurrently with revegetation activities. Additional weed control activities that may be required over the 3-year monitoring period will be discussed with the appropriate oversight agencies prior to implementation.

7. RECORDKEEPING AND TRAINING

7.1 Recordkeeping

The records listed below will be retained for a minimum period of at least 3 years after the permit is terminated:

- City of Kalamazoo Soil Erosion and Sedimentation Control Permit (Appendix A)
- Copy of permit application (Appendix A)
- MDEQ Approval Letter (Appendix A)
- Inspection Reports (Appendix E)
- Corrective Action Logs (Appendix F)
- Training logs (Appendix H)

7.2 Availability and Amendment of Plan

A copy of the Soil Erosion and Sedimentation Control Plan will be maintained at the Site at all times. The plan will be made available to Site personnel for review. The plan will be amended whenever there is a change in design, construction, operation, or maintenance that materially affects the Site's potential to damage or harm the environment. The plan will also be amended if new regulations are promulgated to ensure that the plan and its implementation are current. All amendments of significance to the plan will be approved by the FOSC or designated government representative. All revisions to the plan must be documented on an Amendment Log located in Appendix G until the Plan can be amended.

7.3 Training of Site Personnel

All personnel working at the Site (including subcontractors) should be familiar with the requirements of this Soil Erosion Control and Sedimentation Plan and are required to attend a site-specific safety orientation presentation. This site-specific safety orientation will include training on all phases of environmental protection. The training will include methods of detecting and avoiding pollution, installation and care of erosion controls, and spill prevention

and response. Training will be provided prior to beginning work, and refresher training will be provided as necessary.

Training for those individuals with specific storm water responsibilities (e.g., installing, inspecting, and maintaining BMPs) and for subcontractors is especially important and must be documented. Documentation should include the date of training, the names of attendees, subjects covered, and length of training. A Training Log is provided in Appendix H.

8. CERTIFICATION OF PLAN

The Soil Erosion and Sedimentation Control Plan should be signed and certified by the construction operator(s).

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: Eric Bowman **Title:** EQ Project Manager

Signature: Eric Bowman **Date:** 9/16/2011

A

APPENDIX A

PART 91, SOIL EROSION AND SEDIMENTATION CONTROL ACT, SOIL EROSION AND SEDIMENTATION CONTROL PERMIT, PERMIT APPLICATION, AND MDEQ LETTER OF APPROVAL

BA PAY ENV

PERMIT APPLICATION for Part 91
SOIL EROSION AND SEDIMENTATION CONTROL
(SESC Permit)

THE CITY OF Kalamazoo

Development Center
415 Stockbridge Avenue
Kalamazoo, MI 49001

(269) 337-8026

Required documents/documentation:

A Soil Erosion and Sediment Control Plan including drawings and documentation to clearly describe the proposed earth change which describes steps to be taken to effectively reduce accelerated soil erosion and sediment or both, and which shall include but not be limited to the following information:

- ☒ **A MAP AT A SCALE OF NOT MORE THAN 200 FEET TO THE INCH INCLUDING A LEGAL DESCRIPTION AND SITE LOCATION SKETCH WHICH INCLUDES THE PROXIMITY OF ANY PROPOSED EARTH CHANGES TO LAKES OR STREAMS, OR BOTH; AND CONTOUR INTERVALS OR SLOPE DESCRIPTION.**
- ☒ **A SOILS SURVEY OR WRITTEN DESCRIPTION OF THE SOIL TYPES OF THE EXPOSED LAND AREA CONTEMPLATED FOR EARTH CHANGE.**
- ☒ **A DESCRIPTION AND LOCATION OF THE PHYSICAL LIMITS OF EACH PROPOSED EARTH CHANGE.**
- ☒ **A DESCRIPTION AND LOCATION OF ALL EXISTING AND PROPOSED ON-SITE DRAINAGE FACILITIES.**
- ☒ **THE TIMING A SEQUENCE OF EACH PROPOSED EARTH CHANGE.**
- ☒ **A DESCRIPTION AND THE LOCATION OF ALL PROPOSED TEMPORARY SOIL EROSION CONTROL MEASURES.**
- ☒ **A DESCRIPTION AND LOCATION OF ALL PROPOSED PERMANENT SOIL EROSION CONTROL MEASURES.**
- ☒ **A PROGRAM PROPOSAL FOR THE CONTINUED MAINTENANCE OF ALL PERMANENT SOIL EROSION CONTROL FACILITIES WHICH REMAIN AFTER THE PROJECT COMPLETION, INCLUDING THE DESIGNATION OF THE PERSON RESPONSIBLE FOR THE MAINTENANCE. (SUCH MAINTENANCE RESPONSIBILITIES SHALL BECOME PART OF ANY SALES OR EXCHANGE AGREEMENT FOR THE LAND ON WHICH THE PERMANENT SOIL EROSION CONTROL MEASURES ARE LOCATED)**

APPLICATION DATE _____ DATE ISSUED _____ FEE $ _____ PERMIT # ENV

EXPIRATION DATE _____

AUTHORITY:	PART 91, 1994 PA451 & CHAPTER 30	THIS DEPARTMENT WILL NOT DISCRIMINATE AGAINST ANY INDIVIDUAL OR GROUP BECAUSE OF RACE, SEX, RELIGION, AGE, NATIONAL ORIGIN, COLOR, MARITAL STATUS, HANDICAP, OR POLITICAL BELIEFS.
COMPLETION:	MANDATORY TO OBTAIN PERMIT	
PENALTY:	PERMIT WILL NOT BE ISSUED	

1. APPLICANT (Please check if applicant is the landowner or designated agent)

NAME ☐ LANDOWNER ☒ DESIGNATED AGENT
Eric Bowman, Environmental Quality Management, Inc.

ADDRESS
1800 Carillon Boulevard

CITY	STATE	ZIP CODE	AREA CODE / TELEPHONE NUMBER
Cincinnati	Ohio	45240	513-265-8875

2. LOCATION

SECTION	TOWN	RANGE	TOWNSHIP	CITY / VILLAGE	COUNTY
S15	T2S	R11W		Kalamazoo	Kalamazoo

SUBDIVISION	LOT NO.	PROPERTY TAX ID NUMBER	STREET ADDRESS
N/A	N/A	various properties	various locations

3. PROPOSED EARTH CHANGE

PROJECT TYPE: ☐ RESIDENTIAL ☐ MULTI-FAMILY ☐ COMMERCIAL ☒ INDUSTRIAL ☐ LAND BALANCING

DESCRIBE PROJECT
Contaminated Sediments will be removed from Portage Creek as part of a Time Critical Removal Action. Creek will be restored and enhanced post removal.

SIZE OF EARTH CHANGE (acres or square feet) 4 acres.

NAME OF AND DISTANCE TO NEAREST LAKE, STREAM, OR DRAIN
Work will be performed along banks of and within creek.

DATE PROJECT TO START: August 2011

DATE PROJECT TO BE COMPLETED: November 2011

4. SOIL EROSION AND SEDIMENTATION CONTROL PLAN (Refer to Rule 323.1703)

Note: 2 complete sets of plans must be attached.

ESTIMATED COST OF EROSION AND SEDIMENT CONTROL

PLAN PREPARER'S NAME AND TELEPHONE NUMBER: Jill R. Binzer — AREA CODE: 513-825-7500

5. PARTIES RESPONSIBLE FOR EARTH CHANGE

NAME OF LANDOWNER (if not provided in Box No. 1 above)
various landowners

ADDRESS

CITY	STATE	ZIP CODE	AREA CODE / TELEPHONE NUMBER

NAME OF INDIVIDUAL "ON SITE" RESPONSIBLE FOR EARTH CHANGE
Eric Bowman

COMPANY NAME
Environmental Quality Management, Inc.

ADDRESS	CITY	STATE	ZIP CODE	AREA CODE / TELEPHONE NUMBER
1800 Carillon Boulevard	Cincinnati	OH	45240	513-265-8875

6. PERFORMANCE BOND

AMOUNT REQUIRED $ 0.00 ☐ CASH ☐ CERTIFIED CHECK ☐ IRREVOCABLE LETTER OF CREDIT ☐ SURETY BOND

NAME OF SURETY COMPANY
N/A

ADDRESS	CITY	STATE	ZIP CODE	AREA CODE / TELEPHONE NUMBER

I (we) affirm that the above information is accurate and that I (we) will conduct the above described earth change in accordance with Part 91, Soil Erosion Sedimentation Control, of the Natural Resource and Environmental Protection Act, 1994 PA 451, as amended, applicable local ordinances, and the documents accompanying this application.

LANDOWNER'S SIGNATURE	PRINT NAME	DATE

DESIGNATED AGENT'S SIGNATURE*	PRINT NAME	DATE

*Designated agent must have a written statement from landowner authorizing him/her to secure a permit in the landowner's name.

Rev. 7/03

APPENDIX B

PROJECT SCHEDULE

APPENDIX C

STATE OF MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY GUIDEBOOK OF BEST MANAGEMENT PRACTICES FOR MICHIGAN WATERSHEDS

Dec. 1, 1992

Filters

Description

Filters are mechanical methods of removing sediment from storm water before the water leaves a construction site. The filter may consist of pea stone, various grades of washed crushed stone, straw, or one of many types of geotextile materials. This BMP includes specifications for filter fences (silt fences), storm drain inlet protection devices, and several other less common types of filtering mechanisms.

This BMP does not address filter or buffer strips. Buffer/Filter Strips is a separate BMP which contains specifications for preserving and establishing vegetation between erodible areas and water courses to filter sediment. This Filters BMP discusses structural filtering devices.

Other Terms Used to Describe

Filter Fence
Flotation Curtain
Geotextile Fabric
Sewer Inlet Protection
Silt Curtain
Silt Fence
Storm Drain Inlet Protection

Pollutants Controlled and Impacts

All filters help retain sediment and attached chemicals, including phosphate, nitrates, metals, and pesticides. The effectiveness of each type of filter is dependent upon the type of material used, design, flow, and proper maintenance. Most filters have limited capacity to control silts and clays, and are most effective in filtering larger sand-sized particles.

By collecting sediment, filters will help reduce the maintenance of storm sewers and other underground piping systems.

Application

Land Use
The filters discussed in this practice are most applicable to construction sites.

Soil/Topography/Climate
Most filters are suitable for retaining sand. Only specialized geotextile materials are suitable for retaining clay, silt and other fine soils. Geotextile materials used to control fine soils clog up quickly, and should be replaced frequently.

When to Apply
Filters used in conjunction with Check Dams, Sediment Basins, Diversions and areas subject to runoff, should be installed prior to or in conjunction with major earth change activities. Storm sewer inlet filters should be installed as soon as the manhole is capable of receiving storm water.

Geotextile filters should be implemented according to their intended use, and following manufacturer's specifications.

Where to Apply
The location for installing these practices is site-specific and material-specific. See the "Specifications" section, below.

Relationship With Other BMPs

The following is a list of BMPs and the type of filter most often used in conjunction with them. Refer to the underlined BMP for additional information.

Sediment Basins. Stone is placed around the perforated riser pipe to filter sediment-laden water from runoff, or at the outlet of the sediment basin.

Dewatering operations. Geotextile materials are used to filter soil from water pumped during dewatering.

Diversions. Stone is placed at the hydraulic outlet point.

Check Dams. Although the primary purpose of a check dam is to reduce velocity, it may also be used to filter sediment. Burlap or geotextile bags filled with sand, pea stone or washed crushed stone may be added to the check dam design to provide filtering benefits in addition to reducing the flow velocity.

Specifications

General Considerations:
The filters below are listed according to the specific purpose for which they were intended. Note that straw bales are not recommended as filters, since upon becoming saturated, they swell and act as dams. If straw bales are used, they must be trenched in and replaced before they become water-logged.

Many of the practices below rely on the use of geotextile materials. These materials are manufactured to control the rate of storm water flow, and to cause deposition up-slope of the material. They are constructed like a sieve to prevent certain sizes of soil particles from passing through the system, yet allowing water to pass through.

Geotextile fabrics come in a variety of materials. All fabric materials come with permeability, strength and durability ratings. In all cases, follow the manufacturer's recommendations for the specific product application, installation and maintenance. Suppliers of geotextile fabrics are listed in the Appendices.

1. **Protecting storm sewer and catch basin inlets.** Filters are used around catch basins and storm sewer inlets to filter sediment-laden water and maintain the integrity of the storm sewer and/or catch basin. All inlet protection practices should be constructed so that the structure can be easily cleaned out and maintained, and so that any resulting ponded stormwater will not cause excessive inconvenience or damage to adjacent areas or structures. These inlet protection practices are most effective in small drainage areas.

A. Excavated Drop Inlet Sediment Trap. Where the storm sewer can be left below the final grade, a depression in the ground adjacent to the manhole can be an effective way of protecting the sewer. The runoff water is directed to the depression and the sediment allowed to settle out in the pre-fabricated filter. See Exhibit 1 for specifications on this practice.

B. Sod Inlet Filter. This practice should only be used to filter sheet flow in areas which have been final graded and seeded. It is designed to protect the inlet from sediment while all other permanent vegetation is being established. (See Exhibit 2).

C. Geotextile Inlet Filter. This method consists of placing filter fence around the perimeter of the storm inlet. Apply this method where the inlet drains gentle slopes and sheet or overland flow. See Exhibit 3.

D. Geotextile-Stone Filters. These are used both on storm inlets and in street curbs and gutters. Exhibit 4 is simply constructed of geotextile materials over the inlet, with stone on top. The geotextile-stone inlet device may be used when flows in the street are such that if the geotextile filter fabric becomes clogged during a typical storm, the ponded water would not cause damage or inconvenience. Because burlap rots rapidly when it is exposed to sunlight and moisture, use burlap in place of geotextile material only if it is replaced frequently.

E. Exhibit 5, the Modified Geotextile-Stone Filter is used only on curb and gutter inlets. This practice makes use of wire mesh, wood, filter cloth and stone, and should be used to prevent larger volumes of water from ponding in the street. If the geotextile-stone inlet device in Exhibit 4 isn't adequate, modify it according to Exhibit 5 to accommodate greater flows.

F. Block and Gravel Drop Inlet Filter. This practice is used around storm sewers in areas where heavy flows are expected and where an overflow capacity is necessary to prevent excessive ponding around the structure. See Exhibit 6.

G. Block and Gravel Curb and Gutter Inlet Filter. This is similar to the geotextile-stone inlet filters, except that concrete blocks are used. Follow the specifications in Exhibit 7.

2. **Filter Fences.** *When properly installed and maintained,* filter fences are very effective filtering devices adjacent to streams and wetlands. They are most effective on slopes that are not very steep or long. Place at the base of the slope and only in areas of sheet flow. **Do not use in areas of concentrated flow.** Follow the installation and maintenance specifications in Exhibits 8 and 8a.

3. **Filter bags used as part of a dewatering operation.** Geotextile filter bags are often used as part of a Dewatering operation. Water which is pumped from construction activities should be pumped through filter bags, a grass Buffer/Filter Strip, or a Sediment Basin before it enters a water course.

i. The filter bag should be constructed with a needle-punched, non-woven fabric.

ii. The seams of the filter bag may be sewn, nailed between 2" x 4"s, or connected by some positive method of closure. The seams should be strong enough to withstand pumping pressures, sediment loads, and transportation by the contractor to an upland site for disposal.

4. **Floatation silt (turbidity) curtains.** These are silt barriers used in non-flowing water such as a lake or pond. The silt curtain consists of a filter fabric curtain weighted at the bottom and attached to a floatation device at the top. Its purpose is to isolate an active construction area within a lake or stream to prevent silt-laden water from migrating out of the construction area. See Exhibit 9 for specifications for this practice.

5. **Filters as additional protection under structures and similar practices.** Filter fabric can be used under Riprap, and seawalls/retaining walls and other Slope/Shoreline Stabilization structures. Lay filter fabric underneath these structures to allow groundwater seepage and retain soil particles. Consult the "Supplies of Geotextile Filter Fabric," Appendix 6, for specific applications.

6. **Filters as detention berms.** On sites which may benefit from temporary terracing, the developer may opt instead to construct a series of large rock piles (which also act as check dams) along a slope to filter sediment-laden water. See the Check Dams BMP for this application.

7. **Stone filters as outlets for sediment basins and diversions.** The area between a Sediment Basin and a stabilized outlet should consist of stone with or without geotextile material under it. The outlet for a Diversion can also be a stone filter. See also the Stabilized Outlets BMP.

Maintenance

Effective filters will collect sediment, particularly when the soil is sandy. Filters must be cleaned periodically so they don't become clogged and cause flooding conditions, piping, or overtopping of the control structures. Filter fencing which sags, falls over, or is not staked in, should be promptly repaired or replaced.

Exhibits

Exhibit 1: Excavated Drop Inlet Sediment Trap. Michigan Soil Erosion and Sedimentation Control Guidebook, and USDA Soil Conservation Service.

Exhibit 2: Sod Inlet Filter. Modified from Virginia Erosion and Sediment Control Manual.

Exhibit 3: Geotextile Inlet Filter. Modified from Virginia Erosion and Sediment Control Manual.

Exhibit 4: Geotextile-Stone Inlet Filter. Virginia Erosion and Sediment Control Manual.

Exhibit 5: Modified Geotextile-Stone Filters for Storm Inlets and Catch Basins. Text: Modified from 1983 Maryland Standards and Specifications for Soil Erosion and

Sediment Control. Graphic: USDA, Soil Conservation Service, College Park, Md.

Exhibit 6: Block and Gravel Drop Inlet Filter. Modified from Virginia Erosion and Sediment Control Manual.

Exhibit 7: Block and Gravel Curb and Gutter Inlet Filter. Modified from Virginia Erosion and Sediment Control Manual.

Exhibit 8: Silt Fence (Filter Fence). Text: Several sources.

Exhibit 8a: Filter Fences. Oakland County, Michigan, Erosion Control Manual.

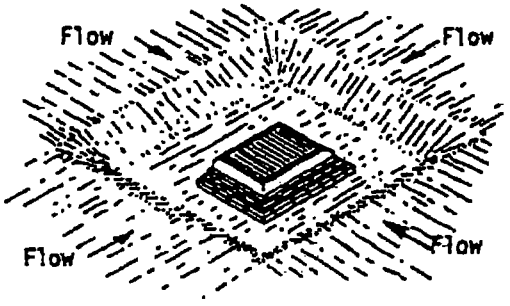
Exhibit 9: Silt (Turbidity) Curtains. Protecting Water Quality in Urban Areas: Best Management Practices for Minnesota.

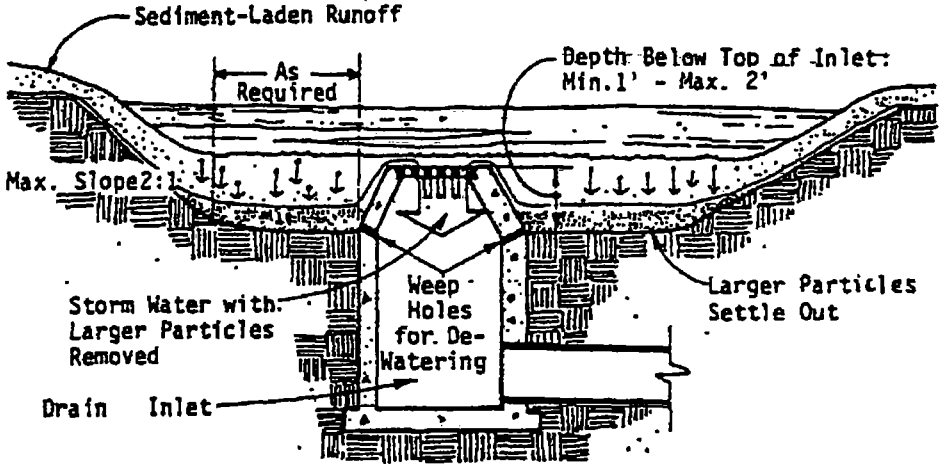
Exhibit 1

Excavated Drop Inlet Sediment Trap

Use:
Use in areas where heavy flows are anticipated.

1. The excavated trap should be sized to provide a minimum storage capacity calculated at the rate of 135 cubic yards for 1 acre of drainage area. A trap should be no less than 1 foot, nor more than 2 feet deep measured from the top of the inlet structure. Side slopes should not be steeper than 2:1.
2. The slopes of the basin may vary to fit the drainage area and terrain. Observations should be made as necessary to ensure satisfactory trapping of the sediment.
3. Where an inlet is located so as to receive concentrated flows, such as in a highway median, it is recommended that the basin have a rectangular shape in a 2:1 ratio, with the length oriented in the direction of the flow.
4. Sediment should be removed and the trap restored to the original dimensions when the sediment has accumulated to 40% the design depth of the trap. Place any removed sediment in a manner consistent with the Spoil Piles BMP.
5. During final grade, the inlet should be protected with a geotextile-stone filter. Once final grading is achieved, a sod inlet filter should be implemented to protect the inlet until permanent vegetation is established.





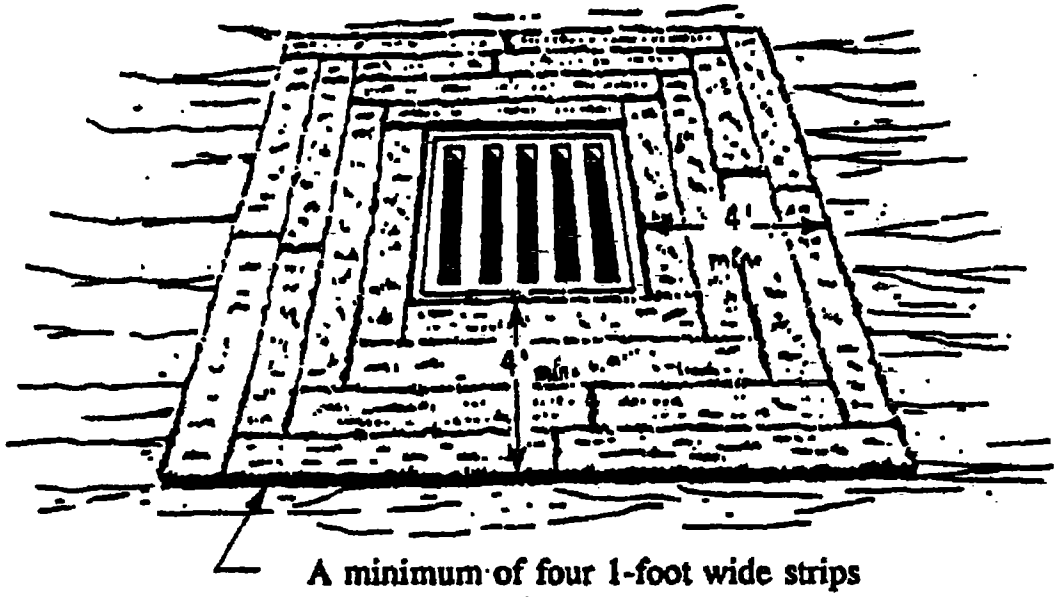
Source: Modified from the Virginia Erosion and Sediment Control Manual.

Exhibit 2

Sod Inlet Filter

Use:
Use in areas which are not stable on any and all sides. An alternative method to the Burlap or Geotextile Inlet Filter.

1. Use only to filter sheet flow and in areas which have been final graded and seeded for vegetative cover.
2. This practice may be used in conjunction with a stone filter around the inlet.
3. The minimum sod requirement is 4 feet on each side of the inlet. The width of the sodded area should increase based on the slope of the drainage area.
4. Sod should be laid so that the anticipated runoff does not flow directly into the inlet between the pieces of sod. This is best done by laying the sod like masonry bricks (i.e. off-setting every other row.) See Exhibit 3 for the proper placement of the sod.
5. Select sod type, prepare sodbed, lay, and stake sod following the specifications in the Sodding BMP.
6. Maintenance should be done following each rain to ensure the sod is adequately filtering the runoff. Stone filters around the inlet may be added, as necessary.



A minimum of four 1-foot wide strips on each side of the drop inlet

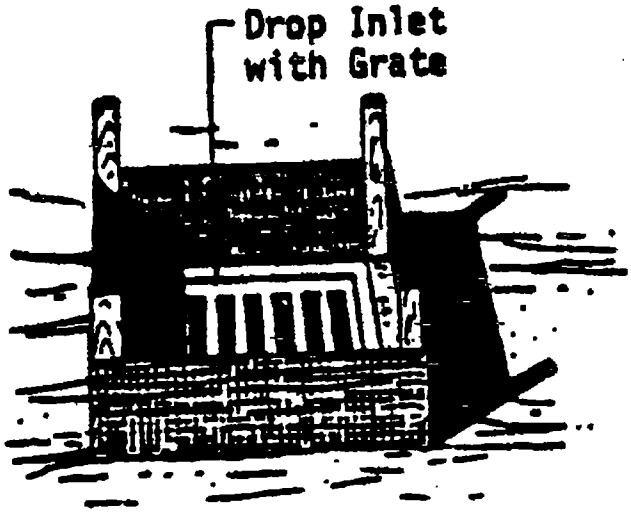
Source: Modified from Virginia Erosion and Sediment Control Manual.

Exhibit 3

Geotextile Inlet Filter

Use:
Use around the perimeter of inlets in areas which are not stabilized on any or all sides.

1. Filter fabric should have ultraviolet protection and be strong enough to maintain effectiveness under anticipated flows. It should come from a continuous roll and otherwise meet the specifications for filter fabric.
2. Stakes should be 1 1/8" x 1 3/8" finished wood or equivalent metal with a minimum length of 3 feet (36 inches).
3. Staples should be of heavy duty wire at least 1/2-inch long.
4. Stakes should be spaced around the perimeter of the inlet a maximum of 3 feet apart and driven into the ground a minimum of 8 inches.
5. A trench should be excavated around the perimeter of the inlet and the fencing materials placed in the trench. The trench should be 4" wide and 6" deep.
6. Staple the material to the stakes.
7. After lowering the bottom of the material into the trench, backfill with soil and make a small ridge on the up-slope side of the filter material. The geotextile material above the soil should be approximately 16 inches, minimum.
8. The material in the last corner to be completed should overlap with the material from the first one by six inches. Wrap the ends and staple to both posts.



Source: Modified from Virginia Erosion and Sediment Control Manual.

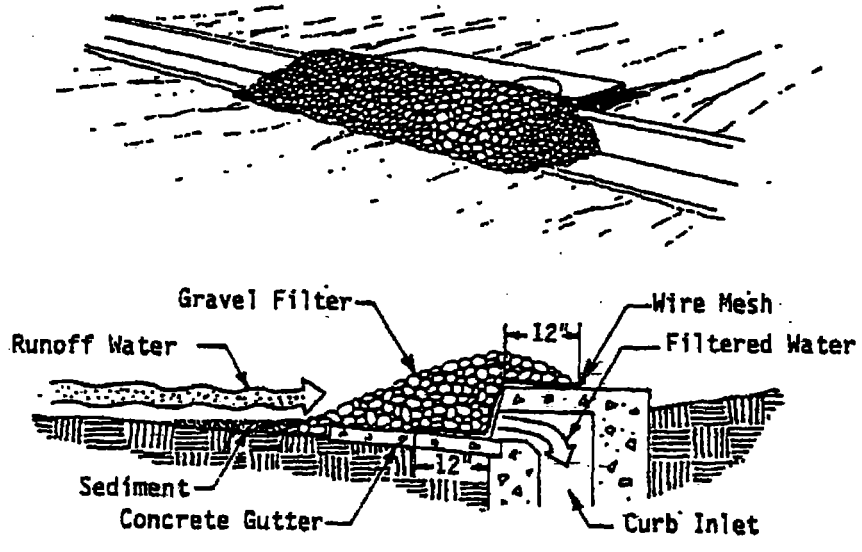
Exhibit 4

Geotextile-Stone Inlet Filters

Use:
Simple stone filters can be used on storm inlets where flows are minimal. They can consist of laying geotextile or wire material on top of the storm sewer and laying approximately six inches of 2-inch clean aggregate on top. This method can also be used on curb and gutters, though the method in Exhibit 5 is preferred.

Maintenance must be done regularly, especially after storms. When clogging occurs, remove the old geotextile material and stone and replace with new material and either clean stone.

Extra support can be provided by placing hardware cloth or wire mesh across the inlet cover. The wire should be no larger than 1/2" mesh and should extend an extra 12 across the top and sides of the inlet cover. See the diagram below.



Specific Application

This method of inlet protection is applicable at curb inlets where ponding in front of the structure is not likely to cause inconvenience or damage to adjacent structures and unprotected areas.

Source: Modified from Virginia Sediment Control Manual.

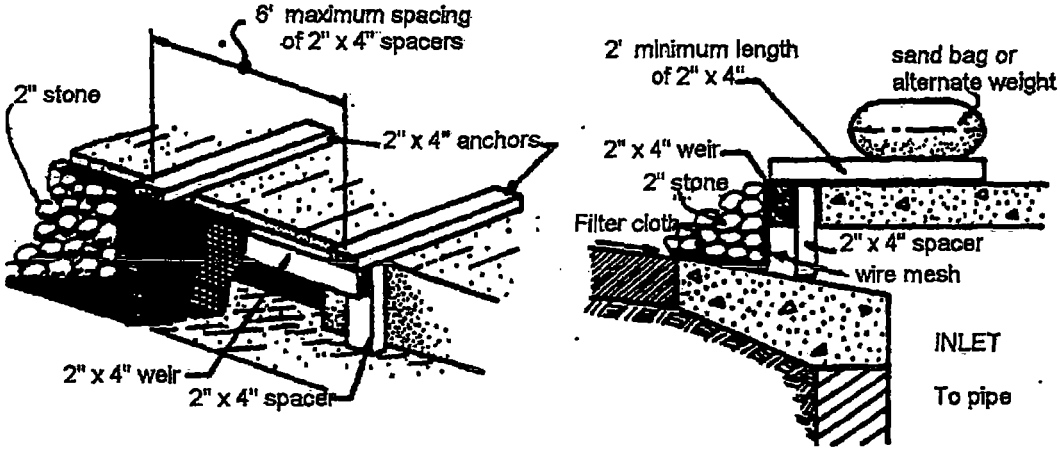
Exhibit 5

Modified Geotextile-Stone Filter
For Storm Inlets and Catch Basins

Use:
Use this method on curb and gutter inlets and storm sewer inlets where overflow capability is needed to prevent excessive ponding in front of the structure.

1. The wire mesh must be of sufficient strength to support filter fabric, and stone for the curb inlets, with water fully impounded against it.
2. The filter cloth must be of a type approved for this purpose, resistant to sunlight, and a sieve size sufficient enough to allow passage of water and the removal of sediment.
3. Use 2" stone. It must be clean.
4. Attach a continuous piece of wire mesh (30" minimum width by throat length plus 4') to the 2" X 4" weir (measuring throat length plus 2') as shown on the drawing.
5. Place a piece of approved filter cloth (40-85 sieve) of the same dimensions as the wire mesh over the wire mesh and securely attach to the 2" X 4" weir.
6. Securely nail the 2" X 4" weir to 9" long vertical spacers to be located between the weir and inlet face (maximum 6' apart).
7. Place the assembly against the inlet throat and nail minimum 2' lengths of 2" X 4" to the top of the weir at spacer locations. These 2" X 4" anchors should extend across the inlet top and be held in place by sandbags or alternate weight.
8. Place the assembly so that the end spacers are a minimum 1' beyond both ends of the throat opening.
9. Form the wire mesh and filter cloth to the concrete gutter and against the face of curb on both sides of the inlet. Place clean 2" stone over the wire mesh and filter fabric in such a manner as to prevent water from entering the inlet under or around the filter cloth.
10. This type of protection must be inspected frequently and the filter cloth and stone replaced when clogged with sediment.
11. Assure that storm flow does not bypass inlet by installing temporary earth or asphalt dikes directing flow into the inlet.

Modified from 1983 Maryland Standards and Specifications for Soil Erosion and Sediment Control.



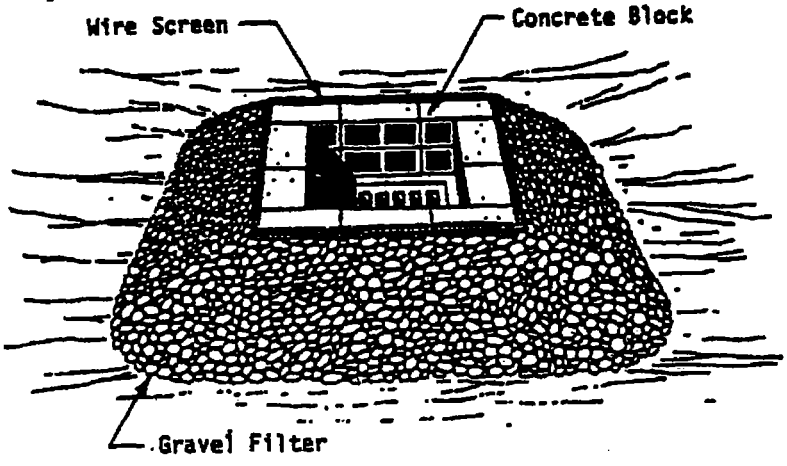
Source: USDA, Soil Conservation Service, College Park, Md.

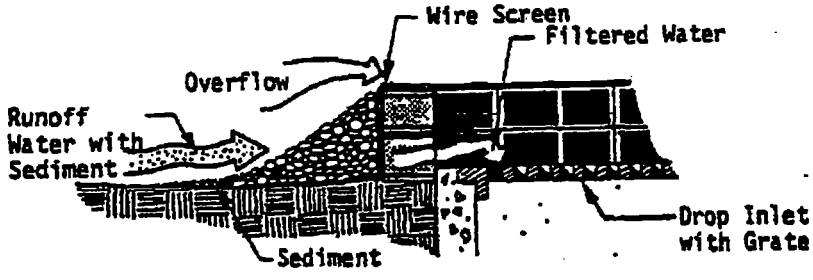
Exhibit 6

Block and Gravel Drop Inlet Filter

Use:
Use where heavy flows are expected and where an overflow capacity is necessary to prevent excessive ponding around the structure.

1. Place 4" X 8" X 12" concrete blocks lengthwise on their sides in a single row around the perimeter of the inlet, with the ends of adjacent blocks abutting. The height of the barrier can be varied, depending on design needs, by stacking combinations of the same size blocks. The barrier of blocks should be at least 12 inches high and no greater than 24 inches high.
2. Wire mesh should be placed over the outside vertical face (webbing) of the concrete blocks to prevent stone from being washed through the holes in the blocks. Hardware cloth or comparable wire mesh with 1/2-inch openings should be used.
3. Two-inch stone should be piled against the wire to the top of the block barrier, as shown in the diagram.
4. If the stone filter becomes clogged with sediment so that it no longer adequately performs its function, the stone must be pulled away from the blocks, cleaned and replaced, or new stone replaced.





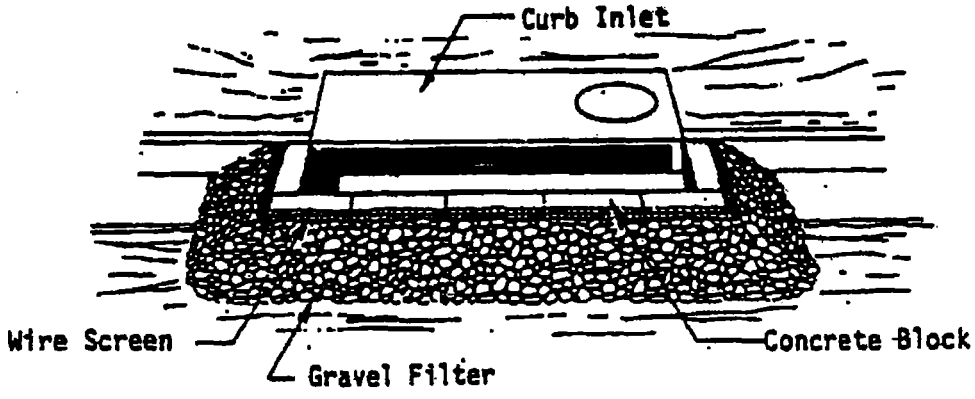
Source: Modified from Virginia Erosion and Sediment Control Manual

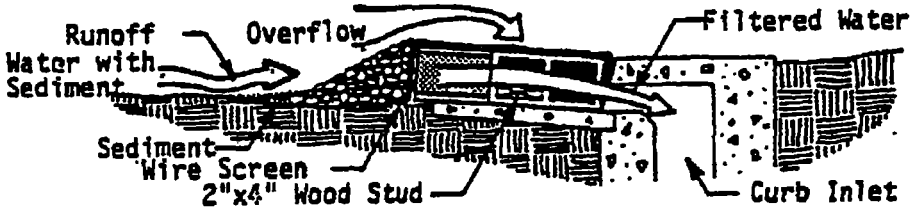
Exhibit 7

Block and Gravel Curb and Gutter Inlet Filter

Use:
Use this method on curb and gutter inlets and storm sewer inlets where overflow capability is needed to prevent excessive ponding in front of the structure.

1. Place two concrete blocks on their sides abutting the curb at either side of the inlet opening. These blocks provide a space between the filtering stone and the inlet.
2. Cut a 2" X 4" stud and place it through the outer holes of each spacer block to keep the front blocks in place.
3. Place additional concrete blocks on their sides across the front of the inlet and abutting the spacer blocks. Refer to the diagram above.
4. Place wire mesh over the outside vertical face (webbing) of the concrete blocks to prevent stone from being washed through the holes in the blocks. Use chicken wire or hardware cloth with 1/2-inch opening.
5. Pile 2" stone against the wire to the top of the barrier, as shown in the diagram.
6. If the stone filter becomes clogged with sediment so that it no longer performs as a filter, the stone must be removed and either cleaned and replaced, or a clean set of aggregate placed.





Source: Modified from Virginia Erosion and Sediment Control Manual.

Exhibit 8

Filter Fences

Use:
Use to control sheet flow only (not concentrated flow). Use adjacent to critical areas, wetlands and watercourses and at the base of slopes. Slopes should be no steeper than 2:1. Drainage should be 1/2 acre per 100 feet of fence.

Do not use in live streams, ditches or swales.

Specifications:
The fabric should be non-woven and composed of at least 95% propylene or ester polymers. It should be certified by the manufacturer or supplier as conforming to the specifications below. Because of the potential for clogging, non-woven materials are not to be used.

The following criteria will meet the requirements of Michigan Department of Transportation 1990 Standard Specifications, Section 8.09.06, and should be used as guidance in selecting geotextile filter fencing.

Physical Characteristics

Typical fence length:	100 ft.
Fabric width	24" minimum
Post length	36" minimum
Post size	1 1/8" x 1 3/8" finished
Post pointing	Rotary (pencil style)
Post composition	No. 1 common hardwood
Geotextile/post connection	Stapled or pocketed

Mechanical/hydraulic Characteristics:		Testing Procedure
Grab tensile strength	100 lbs.	ASTM D-4632
Trapezoid Tear Strength	45 lbs.	ASTM D-4533
Mullen Burst Strength	280 psi	ASTM D-3786
U.V. Resistance	70%	ASTM D-4355
Water Flow Rate	30 gpm/sf	ASTM D-4491
AOS	0.6 mm minimum	ASTM D-4751

Source: Price and Company, Inc., Grand Rapids, Michigan.

Installation:
In most situations, pre-fabricated materials (i.e. those with posts already attached) can be used. However, on rolling terrain, pre-fabricated fences are difficult to install. On rolling terrain, fences should be assembled in the field.

Install along a contour line of equal elevation.

1. Dig a 6-inch trench along the area in which the fence is to be located.
2. Place 6 inches of the bottom of the fabric into the trench. Some manufacturer's include lines on the bottom of the fabric to indicate the approximate 6-inch line. Make sure the fence is taught.

(Con't.)

Exhibit 8a (Con't.)

3. Backfill the trench and compact the soil on both sides. Make a small ridge on the up-slope side. (See the Exhibit).
4. Place wooden stakes or metal re-rod a maximum of 7'8" apart. The stakes' re-rod should be pounded into the ground, on the down-slope side, a minimum of 8 inches.
5. Staple the geotextile material onto the wooden stakes using metal staples recommended by the manufacturer (minimum 1/2-inch long). Tie metal posts to the fence with wire.
6. Stabilize the area down-slope of the site with grass and/or sod.

For Reinforcement:

Filter fences can be reinforced with 1/2"-inch mesh wire placed on the down-slope side and supported with 2 X 4s. Use a minimum 14 gage wire and a maximum mesh spacing of 6 inches.

Maintenance

1. Silt fences should be inspected immediately after each rainfall and several times during prolonged rainfalls.

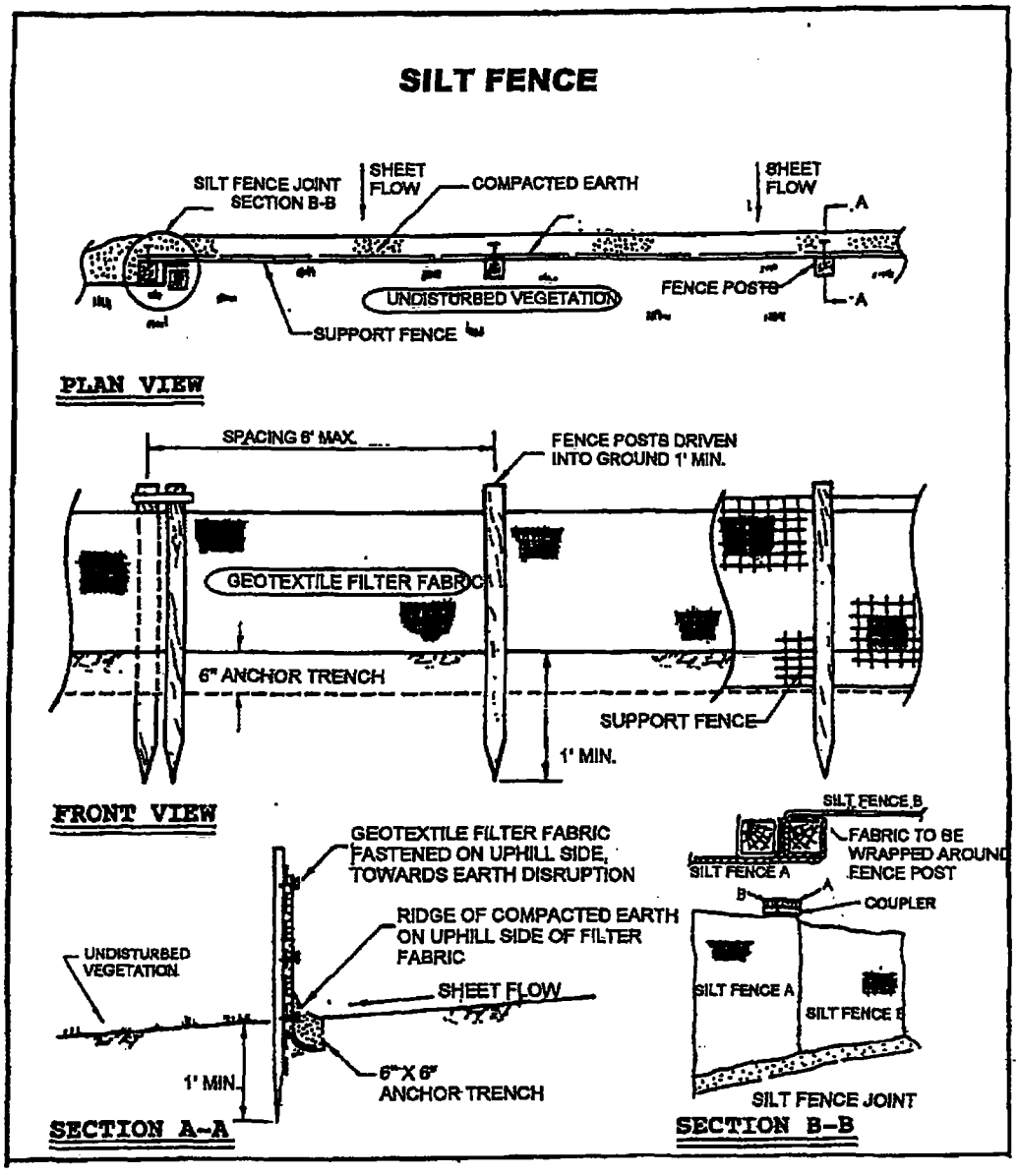
2. If the fence is sagging or the soil has reached one half the height of the fabric, the soil behind the fabric must be removed and disposed of in a stable upland site. The soil can be added to the spoil pile. (See the Spoil Piles BMP).

3. If the fabric is being undercut (i.e. if water is seeping under the fence), the fence should be removed and reinstalled following the procedures given above.

4. Fabric which decomposes or otherwise becomes ineffective should be removed and replaced with new filter fabric immediately.

5. Filter fences should be removed once vegetation is well established and the up-slope area is fully stabilized.

Exhibit 8a



Source: Oakland County (Michigan) Erosion Control Manual.

Exhibit 9

Silt (Turbidity) Curtains

Use:
In lakes adjacent to construction areas and in-stream parallel to the streambank. Used to prevent in-stream sedimentation.

The following specifications are minimum performance standards for suspended solids applications. The following assumptions were made:

-that the primary pollutant is suspended solids (i.e. sand, clay and/or silt). Other types of silt curtains must be used to control other types of pollutants.
-that the silt curtain will be used for no more than one full construction season, (or less, depending on the severity of exposure)

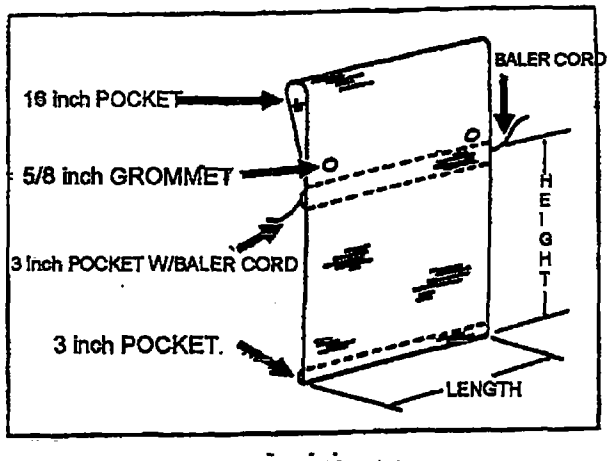
1. The turbidity curtain should be a pre-assembled system including floatation mechanisms, geotextile/geomembrane, bottom weights, securing/tie-off mechanism and joining mechanism.

2. The curtain should be constructed of mechanically-bound, non-woven material consisting of long-chain polymeric fibers. The fibers must be composed of at least 95% propylene or ester polymers. The fibers should be produced in a manner which achieves a stable network.

3. Use Table 1 to determine the appropriate specifications based on the wave height expected in the project area. This table delineates product requirements for a given set of conditions. In no way should a turbidity curtain be extended across or around the flow-path of any inlet structure or waterway without due regard to piping potential, water conveyance needs and clogging potential. If used in streams, the curtain must be placed parallel to the flow of water.

4. Requirements for tie-down locations are site-specific. The number of locations is dependent on the desired shape of the ensuing containment, exterior currents, size of project, etc.

5. Maintain the silt curtain until the construction is stabilized and turbidity is reduced to acceptable levels.



(Con't.)

Exhibit 9 (Con't)
Table 1

Specifications for Wave Heights Less than 6 Inches:

Property	Required[1] Value	Unit	Test Procedure
Tensile Strength	200	lbs	ASTM D-4632
Tensile Elongation	50	%	ASTM D-4632
Mullen Burst	350	psi	ASTM D-3786
Trapezoidal Tear Strength	75	lbs	ASTM D-4533
Puncture Strength	100	lbs	ASTM D-3787[2]
Apparent Opening Size (max)	0.210	mm	ASTM D-4751
Permittivity	1.3	1/sec	ASTM D-4491
U.V. Resistance (150 hrs.)	70	%	ASTM D-4355

Specifications for Wave Heights of 6 - 12 Inches:

Property	Required[1] Value	Unit	Test Procedure
Tensile Strength	360	lbs	ASTM D-4632
Tensile Elongation	50	%	ASTM D-4632
Mullen Burst	650	psi	ASTM D-3786
Trapezoidal Tear Strength	160	lbs	ASTM D-4533
Puncture Strength	225	lbs	ASTM D-3787[2]
Apparent Opening Size (max)	0.210	mm	ASTM D-4751
Permittivity	0.7	1/sec	ASTM D-4491
U.V. Resistance (150 hrs.)	70	%	ASTM D-4355

Specifications for a Minimum Curtain Height of 10 Feet:

Property	Required[1] Value	Unit	Test Procedure
Tensile Strength	400	lbs	ASTM D-4632
Tensile Elongation	50	%	ASTM D-4632
Mullen Burst	700	psi	ASTM D-3786
Trapezoidal Tear Strength	160	lbs	ASTM D-4533
Puncture Strength	180	lbs	ASTM D-3787[2]
Apparent Opening Size (max)	0.210	mm	ASTM D-4751
Permittivity	0.7	1/sec	ASTM D-4491
U.V. Resistance (150 hrs.)	70	%	ASTM D-4355

[1] The Required Value refers to the average minimum value associated with the geotextile's weaker principal direction (when directional difference is possible).

[2] Tension testing machine with ring clamp; steel ball replaced with a 5/16" diameter solid steel cylinder with flat tip centered within the ring clamp.

Source: Price and Company, Inc. Grand Rapids, Michigan.

Dec. 1, 1992

Access Road

Description

Access roads are graveled areas or pads which allow construction equipment and workers to enter and leave the work site from a public right-of-way, street, alley, sidewalk or parking area. This practice provides for the delivery and removal of construction equipment and materials in a manner which will protect vegetative cover, prevent erosion, and protect water quality. Access roads should be used on all construction sites and in forestry and mining to allow the mud on tires to fall off onto the access road before vehicles enter the main (primary road). In urban and urbanizing areas, this practice may reduce the frequency in which street sweeping is done.

Other Terms Used to Describe

Ingress Road
Egress Road
Driveway
Haul Road
Stabilized Construction Entrance

Pollutants Controlled and Impacts

Access roads effectively confine construction equipment to one or more specific area(s), thereby minimizing the amount of vegetation disturbed and reducing the potential for soil erosion.

Application

Land Use
Use anywhere equipment or vehicular access is necessary, including, but not limited to: transportation (highway construction, drain work); urban (private development, commercial and industrial development); forestlands (forest management,); mining (drilling and mining); and recreation (development of recreational facilities).

Soil/Topography/Climate
Access roads are particularly important in areas that have highly erodible soils, soft soils, or steep slopes, including areas subject to rainy conditions or heavy winds.

When to Apply
The location and construction of the access road should be determined during the planning stage of the project. Construction and stabilization of the access road should be completed prior to initiating construction on the project site.

Where to Apply
The road should be located in such a way that it can provide limited and confined access to any construction project. The road should *not* be placed in wetlands, flood plains, rivers, streams, or drains.

Relationship With Other BMPs

Drainage from the road should be diverted to vegetated areas. (See Diversion BMP). Use Seeding and Mulching or Sodding if vegetation is needed alongside the road. Use Watercourse Crossings where access roads cross rivers or other water bodies.

Specifications

Planning Considerations:

1. Select a site which provides for maximum use by all construction vehicles and equipment. Keep a natural Buffer/Filter Strip between the road and all watercourses and wetlands.

2. Determine soil types in the area selected for the access road and tailor the design to the soil type.

3. Access roads that lead to isolated project areas, such as drilling sites or mining activities, commonly cross streams or wetlands. State permits for these crossings will generally be needed, and special precautions may be required to be taken to protect the streams and wetlands.

4. Provide drainage adequate to carry water to a Sediment Basin or other suitable outlet.

Design Considerations:

The information below assumes that the access road will not be turned into a permanent secondary road upon completion of the rest of the project.

1. Roads which will be located in wetlands should be designed with no shoulders, to accommodate one-way traffic only, and have a minimum top width. Slopes should be 2:1.

2. Roads which will not impact wetlands should be designed based on the following specifications.

    a. The road should be a minimum of 10 feet wide, or wide enough to accommodate the width of the largest piece of equipment. Design the road with no shoulders.

    b. Side slopes should be 2:1 or less.

    c. To be effective, the length of the aggregate portion of the road should not be less than 50 feet.

    d. Except on single family resident lots, all other access roads should be underlain with geotextile fabric appropriate for the soil and drainage conditions. Geotextile material improves the stability of the road.

e. Stone size should be 2 inches. Reclaimed or recycled concrete of an equivalent diameter may also be used.

f. The road should consist of not less than 6 inches of the 2-inch aggregate. Aggregate should be placed in uniform, compacted layers of not more than 6 inches, nor less 3 inches.

g. Where access to the construction site is limited in length (such as in urban areas), daily street sweeping may be needed to keep soil that is tracked onto primary roads from reaching sewers.

Construction Considerations:

1. Remove and dispose of all unwanted trees and other vegetation from the area and grade according to Grading Practices specifications.

2. Apply geotextile fabric.

3. Apply the stone and compact it.

After Construction:

If the mud and soil attached to truck tires does not fall off onto the gravel, truck tires should be washed on an area stabilized with crushed stone. The wash area should drain into a Sediment Basin or other suitable outlet. Wash racks may also be used.

Maintenance

Proper maintenance may include adding additional layers of stone when the original stone becomes covered with mud. After each storm event, inspect the road for erosion and make any necessary repairs. It is also important to check and maintain any BMPs which are used in conjunction with this BMP, especially those for drainage. All sediment dropped or eroded onto public rights-of-way should be removed immediately by sweeping.

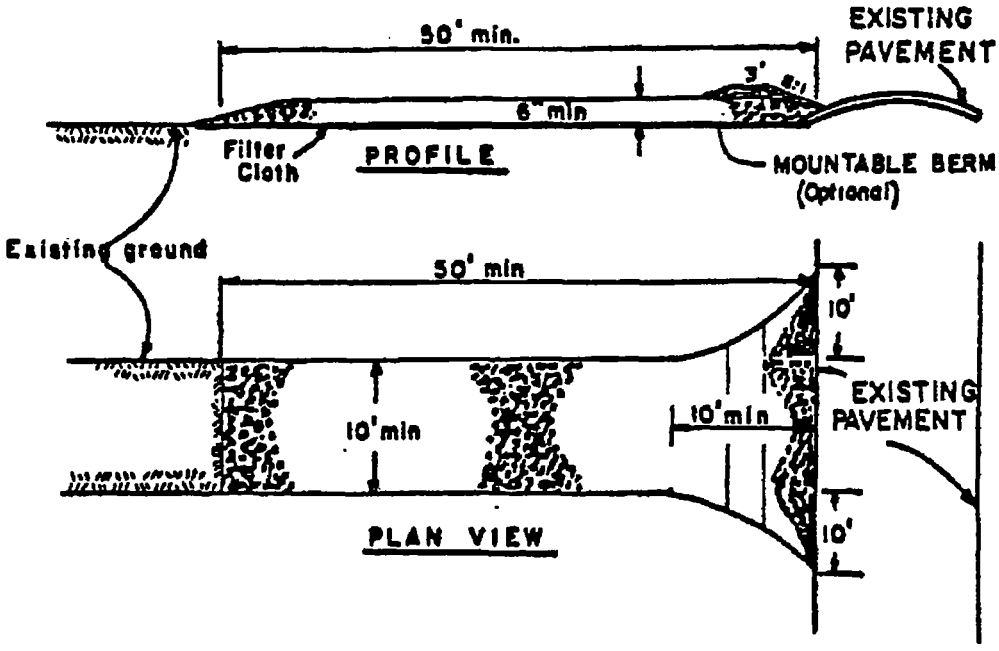
Exhibits

Exhibit 1: Stabilized Construction Entrance. USDA, Soil Conservation Service, College Park, Maryland.

Exhibit 1

Access Road

not to scale



Source: Modified from USDA,Soil Conservation Service, College Park, MD.

Dec. 1, 1992

Construction Barriers

Description

Construction barriers are fences, signs and other means used on a construction site to:

-confine equipment and personnel to the immediate construction area, thus minimizing the destruction of vegetation and reducing the potential for erosion and compaction.

-protect trees and their root zones against abrasion and soil compaction. It takes 20-30 years for newly planted trees to provide the benefits of mature trees.

-prevent unnecessary access to structural BMPs

-protect sensitive areas, such as water bodies and newly seeded areas

-restrict access of unauthorized persons and vehicles.

Other Terms Used to Describe

Fencing

Pollutants Controlled and Impacts

Confining construction activities to a specific site will limit the amount of soil exposed to wind and rain. Effective confinement may also eliminate unnecessary or excessive regrading or revegetation of slopes or raw areas.

Application

Land Use
Use at all construction areas where earth changes are taking place. Land uses include transportation (highway work), urban (drain work, private, commercial and industrial developments), and golf courses.

Soil/Topography/Climate
This practice can be used anywhere, but is particularly important on erodible soils and steep slopes.

When to Apply
Apply this practice prior to the start of construction and as needed throughout the duration of the project. Some barriers, such as vehicle deterrent barriers, may remain in place after project completion.

Where to Apply
Apply anywhere confinement or protection of persons, property or natural resources is needed.

Relationship With Other BMPs

Construction barriers are used to protect critical erosion areas (see Critical Area Stabilization) and to prevent unwanted access by vehicles, equipment and people. It is a component BMP used with many other soil erosion control practices.

Specifications

Planning Considerations:

1. Barriers used to separate the construction area from pedestrian thoroughfares, or used to alert personnel about the existence of hazardous conditions, should be stable and easily discernible.

2. Keep barriers outside the drip line of any trees which will remain intact during and after the construction project. (The drip line is the area from the trunk outward to the a point at which there is no longer any overhanging vegetation). Pounding barriers into the ground within the drip line of trees may cause root damage and weaken the tree. Follow specifications in the Tree Protection BMP.

3. Signs should *not* be nailed or otherwise posted on trees.

4. In large open areas susceptible to wind, consider protecting sprigged or seeded areas with fencing.

5. Barriers are particularly important around detention, retention, and Sediment Basins, and dams (including cofferdams). At a minimum, barriers in these areas should include signs which warn people of potential dangers. Fencing may also be needed, depending upon the slope steepness, outlet flows, depth of water, etc.

   Select appropriate structures for the intended use:

   Temporary structures:
   Temporary fences can be made out of snow fence or the orange plastic fencing which is commonly used in construction areas. Silt fences can also be used as temporary barriers where safety is not a consideration. (See the Filters BMP).

   Permanent structures:
   Permanent fences may be constructed of wood, plastic, synthetic fabric, plastic or any other appropriate material.

   Cyclone-type fences with secure gates and locks should be used around dangerous areas such deep basins.

   Snow fences can be used to prevent pedestrian access and to control wind erosion.

Construction Considerations:

1. Signs should be constructed out of durable materials and printed legibly.

2. Construct the fence following specifications for the type of fence being installed. Be sure all posts are sturdy, and all material is suitable for the intended use. One source of specifications for standard wire, suspension, electric and permanent power fences is the Soil Conservation Service Technical Guide, specifications for Fencing (#382).

3. All fences used as filters should be implemented following specifications in the Filters BMP.

After Construction:

1. Remove all temporary construction barriers. Before leaving the site, inspect all permanent barriers to ensure they are in good working order, and repair where necessary.

2. When removing tree protection barriers, check to make sure the tree is still in good health. Trees which are severely damaged should be removed and replaced. See the Tree Protection BMP for information on replacing trees, and techniques on how to properly repair damaged roots and limbs.

Maintenance

Barriers should be inspected and maintained on a regular basis. Damaged signs and fences should be repaired or replaced immediately.

Dec. 1, 1992

Spoil Piles

Description

Spoil piles are excavated materials consisting of topsoil or subsoils that have been removed and temporarily stored during the construction activity. This BMP addresses spoils which will be stored during most of the construction phases, as well as spoils which will be spread to blend into the natural topography. Specifications for dredged spoils are also included.

Other Terms Used to Describe

Soil Piles
Stock Piles
Storage Piles

Pollutants Controlled and Impacts

Properly placed and stabilized spoil piles will reduce soil erosion.

Application

Land Use
Construction sites and anywhere dredging is done.

Soil/Topography/Climate
All stockpiled soils need to be stabilized because of their highly erodible nature. Even soils subject to quick freezing need to be protected since they will eventually thaw.

When to Apply
Stripping and stockpiling topsoil should be done early in the excavation stage of the project to save all the fertile soil on-site. Subsoils should not be mixed with topsoil and should be stockpiled in stages to minimize the exposure time.

Where to Apply
Apply in all areas where spoil piles are created during grading operations. Also apply in all areas which are dredged.

Relationship With Other BMPs

Spoil piles are usually created during Land Clearing operations. Filter fencing is usually put in at the base of the storage pile to prevent soil from leaving the site. Spoil piles should be stabilized following specifications in the Seeding BMP.

Specifications

For Spoil From Dredging Operations:

1. Spoil collected during dredging should be placed in a manner which will not endanger the stability of any ditch bank. Locate piles a minimum of eight feet from the top of the bank and slope landward to prevent direct drainage from the spoil pile back into the waterway.

2. To prevent both wind and water erosion, piles should not exceed three feet in height above the natural ground surface, except as otherwise approved. Make the piles no steeper than 4:1 (h:v) on the land side, and 3:1 on the channel side if a berm is established. If the spoil is spread to the edge of the channel, side slopes of the spoil should be no steeper than 4:1 and shaped to join the side slope of the ditch bank so loose spoil will not roll or wash into the channel or ditch.

3. Spoil piles should be seeded daily as an area is dredged. Follow the specifications for temporary seeding in the Seeding BMP.

4. Where runoff from the pile may occur, place filter fence at the base of the spoil pile (between the pile and the ditch bank) to help retain soil until vegetation is established. This is especially important on subsoils where vegetation may not grow readily. See the Filters BMP.

For Spoil From Construction Sites:

1. Spoil piles may be located around the perimeter of the project away from the construction activity, or located in the immediate vicinity of the construction. Do not locate spoil piles in or immediately adjacent to wetlands and watercourses, or such that any runoff from the spoil pile will end up in wetlands and watercourses. Include the location of the spoil piles(s) on the soil erosion/sedimentation control plan.

2. Where it is not possible to move the spoil pile upland, place the spoil pile behind a bench or berm to prevent erosion. This is especially important on steep slopes.

3. If runoff can occur, place filter fencing at the base of the spoil pile to help retain soil until vegetation is stabilized. See the Filters BMP.

4. Seed all spoil piles (temporary and permanent) following specifications in the Seeding BMP.

5. Consider placing Construction Barriers around the spoil pile to prevent access by people and equipment.

Excess Stockpiled Soil:
Excess stockpiled soil which is not used as fill or in the preparation of seedbeds or sodbeds should be disposed of in a manner which will not result in the soil running off and impacting surface waters or wetlands. The manner in which this excess soil is disposed of should be included on the soil erosion control plan.

Maintenance

When vegetative stabilization is promptly and effectively applied, very little maintenance is required. The guidelines below should be followed on all sites:

1. Periodic inspections should be done to ensure excessive erosion hasn't occurred. If runoff or wind erosion has occurred, reduce the side slopes of the spoil pile, or stabilize the spoil pile with pieces of sod laid perpendicular to the slope, and staked.

2. When filter fencing is used around a spoil pile, periodic checks should be made to ensure that piping has not occurred under the fencing, and to ensure the fence has not collapsed due to soil slippage or access by construction equipment. Repair any damaged fencing immediately.

3. Berms at the base of the spoil pile which become damaged should be replaced.

Dec. 1, 1992

Staging and Scheduling

Description

Staging is dividing a construction area into two or more areas to minimize the area of soil that will be exposed at any given time. It is done to ensure that as much of the site as possible is stabilized.

Scheduling is a planning process which provides a basis for implementing other BMPs in a timely and logical fashion. In any one development, not all BMPs should be implemented at the same time.

Other Terms Used to Describe

Construction Sequence
Phasing
Sequencing

Pollutants Controlled and Impacts

Staging reduces the likelihood of soil erosion and off-site sedimentation by exposing an area for the shortest time possible. Scheduling reduces water quality impacts by ensuring that BMPs are implemented at the most appropriate time.

Application

Land Use
Use on all construction sites.

Soil/Topography/Climate
Staging and scheduling should be done in all areas, regardless of soil, topography and climate.

When to Apply
Staging and scheduling should begin during the planning phase and continue throughout the construction and stabilization phases. All BMPs which will be implemented on-site should be incorporated into the staging and scheduling process.

Where to Apply
Apply on all projects. This BMP is especially important in areas adjacent to watercourses and on steep slopes, or areas which are susceptible to heavy rains, snowmelt, or strong winds.

Relationship With Other BMPs

The implementation of all temporary and permanent best management practices should be coordinated via staging and scheduling until final stabilization of the site has been accomplished

Specifications

1. Divide the construction site into the number of areas which will be actively developed at any given time. Keep the area and duration of exposure to a minimum. Plan the development phases so that only areas which are actively being developed are exposed. All other areas should be left undeveloped or stabilized with temporary vegetation or mulch.

2. Develop a scheduling sequence for each staged area. The scheduling sequence should list each BMP which will be used on the area, and when the BMP will be implemented, and, if, appropriate, when it will be removed. Follow the example given in the attached exhibit.

The Exhibit: The purpose of staging and scheduling is to install soil erosion and sedimentation control structures, as well as any stormwater structures, in a way which prevents pollutants from leaving the construction site. Exhibit 1 shows the construction sequence of a shopping center in southern Michigan. It is assumed that site plans have been developed. (A site plan should consist of a grading plan, soil erosion/sedimentation control plan, and stormwater control plan). This exhibit also assumes that a pre-construction meeting has taken place, and that MISS DIG has been contacted regarding underground utilities.

Step 1 is to install underground utilities. Step 2 is to stake building sites.

The next several steps should be taken **before** any grading or land clearing: use the Critical Area Stabilization BMP to protect areas prone to erosion; and install soil erosion/sedimentation control measures, including measures such as Diversions, Sediment Basins and silt fences (Filters). All such practices should be on the site plan.

Step 7 is Land Clearing and installing an Access Road.

Following land clearing, topsoil will be removed and stored in Spoil Piles.

Step 9 is grading the area using the Grading Practices indicated on the grading plan.

Next, the schedule calls for installing other temporary erosion control measures. This includes temporary seeding of all areas not under active development, possibly including storage piles.

The next several steps (11-14) are outlined in sequence for the shopping center structure.

Step 15 is establishing a final grade according to Grading Practices, and again, following the grading plan.

The next step is to install permanent stormwater structures, including vegetative controls such as permanent vegetation.

Step 17 calls for removing temporary structures such as silt fences, but **only after the area is stabilized.**

Step 18 is the **ongoing maintenance of all structures.**

Maintenance

Follow the maintenance procedures for each of the BMPs that are used in the construction process. See the individual BMPs.

Exhibits

Exhibit 1: An example Construction Schedule for a Subdivision. Detail CS-1, as modified from MDNR, Soil Erosion and Sedimentation Control Unit.

EXHIBIT 1

Sample Construction Schedule For A Shopping Center
SOIL EROSION AND SEDIMENTATION CONTROL IN SOUTHERN MICHIGAN

CONSTRUCTION ACTIVITY	MONTHS												
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1. Install underground utilities			X	X									
2. Stake building sites		X	X	X									
3. Protect, stabilize critical areas using Critical Area Stabilization	X	X		X	X								
4. Identify and protect Buffer/Filter Strips	X												
5. Implement Tree Protection; Install Construction Barriers	X												
6. Install erosion/sediment control measures (temp/perm.)													
a. Diversions	X		X										
b. Sediment Basins	X		X										
c. Other (Temp. Seeding, Silt Fence, etc.)	X	X	X	X	X								
7. Remove trees, shrubs, etc. using Land Clearing. Install Access Road	X	X											
8. Remove topsoil and store in Soil Piles	X	X											
9. Grade using proper Grading Practices	X												
10. Install other temporary erosion control measures													
a. Seeding/Sodding/Mulching Temporary-Stagging		X		X	X	X							
b. Other													
11. Excavate footings/basement		X	X	X	X						X	X	
12. Construct footings/foundations		X	X	X	X	X					X	X	
13. Construct superstructure			X	X	X	X	X	X	X	X	X		
14. Apply aggregate base to driveways, parking lots, etc.				X	X	X							
15. Final grade according to Grading Practices				X	X	X						X	
16. Implement permanent stormwater control measures:													
a. Vegetative Controls				X	X	X						X	X
b. Others													
17. Remove temp. struct. (upon comp. stabilization) or dormant seeding													X
18. Maintenance of all erosion/sediment measures	X	X	X	X	X	X	X	X	X	X	X	X	X

APPROPRIATE BOXES TO BE DATED BY APPLICANT FOR APPROVED BY ENFORCING AGENCY

Estimated Potential Soil Loss in Tons_____

Dec. 1, 1992

Critical Area Stabilization

Description

Critical area stabilization is stabilizing areas which are highly susceptible to erosion by implementing one or more vegetative or structural BMPs. For the purposes of this BMP, critical areas include areas with highly erodible soils, long or steep slopes, droughty soils, excessively wet soils, soils that are very acidic or alkaline, slopes immediately adjacent to waterbodies or wetlands, fill areas and areas subject to concentrated flows.

Other Terms Used to Describe

High-Risk Erosion Areas
Critical Area Seeding

Pollutants Controlled and Impacts

Protecting critical areas is one of the most effective means of preventing sediment from entering surface waters. Properly established vegetation used to protect critical areas will also help absorb nutrients and reduce flows from steep slopes.

Application

Land Use
Applicable to all land uses.

Soil/Topography/Climate
This practice is particularly important on soils that are excessively wet, droughty, or which are subject to erosion even during a light to moderate rainfall.

When to Apply
Critical erosion areas should be identified during the planning stages of the project or proposed earth change activity. All possible measures should be taken not to disturb these areas. If it is necessary to disturb these areas, attention should be given to protecting them immediately.

Where to Apply
Apply on any area which is difficult to stabilize.

Relationship With Other BMPs

See the "Specifications" section, below.

Specifications

Planning Considerations:

For vegetative practices:

1. All critical areas should be protected from pedestrian access using Construction Barriers.

2. If possible, divert concentrated flows away from critical areas, at least until the vegetation is established. Follow specifications in the Diversions BMP.

3. Select and apply seed and legumes according to specifications in the Seeding BMP. Be sure to select plant species which are tolerant to the site condition.

4. Mulching should be done on seeded areas according to specifications in the Mulching BMP.

5. Sodding should be done according to the Sodding BMP to stabilize areas quickly. Rows of sod can be alternated with rows of seeded areas to stabilize the area more quickly.

6. Dune/sand areas should be stabilized following specifications in the Dune/Sand Stabilization BMP.

7. Trees, shrubs and ground covers should be selected and planted based on the Trees, Shrubs and Ground Covers BMP. Note that Soil Conservation Service soil surveys include species of trees, shrubs and ground covers that work well in each soil texture.

For structural practices:

1. Consider using Grade Stabilization Structures to take concentrated flows from one elevation to the other.

2. Consider using Riprap on slopes adjacent to watercourses and wetlands, and Slope/Shoreline Stabilization on steep slopes and slopes adjacent to cut and fill slopes. The Slope/Shoreline Stabilization BMP includes information on seawalls/retaining walls, revetments, and gabions.

3. Consider using terraces or benches to slow runoff velocities.

4. Consider using Buffer/Filter Strips to control erosion resulting from sheet flow.

5. Subsurface Drains may be needed where water movement may cause seeps or soil slippage. Grassed Waterways may need to be tiled to ensure the vegetation is established.

Site Preparation:

For vegetative practices:

1. Soil tests should be done to determine the nutrient and pH content of the soil. Depending on the results of soil tests, Soil Management may be necessary to adjust the soil pH to between 6.5 and 7.0 (for most conditions). All soil deficiencies should be addressed following the Soil Management specifications.

2. Follow the site preparation sections in the BMPs being used for vegetative establishment.

For structural practices:
Follow the procedures in the selected BMP.

Design and Implementation:
The proper design and implementation of all BMPs used to stabilize critical areas should be done according to the specifications in the selected BMPs.

Maintenance

For vegetative practices:
Periodic inspections should be scheduled to ensure the vegetation is maturing correctly and staying in place.

Once the vegetation is well established:

1. Consideration should be given to removing Construction Barriers. In some areas, it may be beneficial to leave the barriers in place.

2. Vegetation should continue to be watered, when appropriate, to a depth of 1 inch into the sod bed. Water uniformly. See the Lawn Maintenance BMP.

3. Vegetation should be mowed according to its intended use. Follow the mowing specifications in the Lawn Maintenance BMP.

4. Soil testing should be done periodically to determine if the soil requires additional fertilizer or lime. Follow specifications in the Soil Management BMP.

5. Pesticides should only be used following specifications in the Pesticide Management BMP.

6. Spot Seeding should be done as needed on small damaged areas.

For structural practices:
Follow maintenance procedures in the "Maintenance" section of each structural BMP.

Dec. 1, 1992

Dust Control

Description

Dust is generated when vegetation is removed and soil is exposed to wind. Light winds can pick up and transport silty soils, fine sands and clays. Course sands can also become erodible when winds are strong. Soil particles and any attached chemicals such as fertilizer and pesticides may settle out in surface waters. Airborne particles can scour leaves and tender shoots of vegetation. Clouds of dust can create a traffic hazard.

Dust control measures should be implemented to prevent the soil and attached pollutants from leaving the site. Acceptable dust control practices include watering, snow fencing (see the Construction Barriers BMP), using mulch (see the Mulching BMP), establishing vegetation, and using spray-on adhesives.

Pollutants Controlled and Impacts

Maintaining an effective dust control program helps keep the lighter soils (silt, clay) on the site and sustains the textural qualities necessary for good vegetative growth. It also prevents sediment and attached chemicals such as fertilizer and pesticides from entering surface waters.

Application

Land Use
Rural, urbanizing and transportation

Soil/Topography/Climate
Special attention needs to be given to dust control during the drought months of the year when the ground is dry. Less severe conditions usually exist during the fall and winter months when the ground is frozen or covered with snow.

When to Apply
Dust control measures should be applied any time dust is generated on a construction site or road.

Where to Apply
Apply this practice on any area subject to wind erosion; especially construction sites and roads.

Relationship With Other BMPs

Dust control is an alternative control measure for temporary and permanent vegetation on areas that are to be surfaced with impervious materials. Mulching is another method of dust control.

Specifications

1. Use seeding, mulching and sodding to cover bare soil and prevent dust. Follow specifications in the Seeding and Mulching or Sodding BMPs.

2. On larger areas, consider planting trees and shrubs as wind breaks. Follow specifications in the Trees, Shrubs and Ground Covers BMP.

3. Watering should be done at a rate which prevents dust but does not cause soil erosion.

4. Any snow fencing that is used should be installed following manufacturer's specifications.

5. Use spray-on adhesives according to Table 1, below. **We recommend using these adhesives only if other methods cannot be used. Many of these adhesives are messy, sticky and form fairly impenetrable surfaces.**

Table 1

Type of emulsion	Water dilution	Nozzle type	Apply Gal/Acre
Anionic asphalt emulsion	7:1	Coarse spray	1,200
Latex emulsion	12.5:1	Fine spray	235
Resin-in-water emulsion	4:1	Fine spray	300

Source: Excerpted from the Maryland Erosion and Sediment Control Planning and Design Manual.

Maintenance

To prevent dust from becoming a public nuisance and causing off-site damages, dust control should be ongoing during earth change activities.

Dec. 1, 1992

Equipment Maintenance and Storage Areas

Description

The maintenance, repair, cleaning, and storage of construction machinery, vehicles, and equipment should be confined to areas specifically designed and designated for that purpose. This practice includes both open and covered equipment maintenance and storage areas, and emphasizes the importance of controlling runoff from both kinds of storage areas. It is applicable to construction sites as well as existing permanent storage facilities.

Other Terms Used to Describe

Service Area
Shop Area

Pollutants Controlled and Impacts

Equipment storage areas which properly control runoff will prevent oil, grease, solvents, hydraulic fluids, sediment, wash water, and other pollutants from being carried off the area and entering surface waters. Proper use of this practice will also prevent pollutants from filtering into the ground.

Application

Land Use
This BMP applies to all land uses.

Soil/Topography/Climate
Where possible, maintenance/storage areas should be placed on flat areas to prevent surface runoff from entering or leaving the area.

When to Apply
This practice should be implemented at all existing equipment maintenance and storage areas, and whenever construction will be ongoing long enough that construction equipment will need to be stored, serviced, maintained, or repaired on a construction site. Appropriate equipment maintenance/storage sites should be identified before any actual construction begins.

Where to Apply
Apply anywhere equipment is maintained and/or stored.

Relationship With Other BMPs

Where possible, the identification of an appropriate maintenance/storage area should be done before any construction is done on the site. Diversions should be considered to keep runoff from entering the storage area. Pesticides stored and used in the area should be handled, stored and disposed of according to specifications in the Pesticide Management BMP. Smaller quantities of hazardous wastes (i.e. quantities of approximately 1 gallon or less) should be disposed of following the specifications in the Household Hazardous Waste Disposal BMP. Larger quantities of hazardous

waste should be disposed of by consulting the MDNR, Waste Management Division at 517-373-2730.

Specifications

Planning Considerations for New Areas:
Determine site selection based on the following considerations.

If equipment is to be maintained and stored in an open area (i.e. **temporary storage**):

-The site should not be within the drip line of trees.

-The site should not be within 100 feet of a watercourse or wetland. Runoff should be diverted away from watercourses and wetlands.

If equipment is to be maintained and stored in a **permanent structure** (i.e. building):

-The building should not be located within 100 feet of a watercourse

-When possible, the building should not be constructed on or within 100 feet of a wetland.

Under no circumstances should buildings or equipment be located in floodplains, stream beds, or the channel of any watercourse.

General Considerations for All Equipment Maintenance/Storage Areas:

1. Runoff from equipment maintenance/storage areas should be directed to stabilized outlets designed to assimilate the volume and type of pollutants discharged to them. See the Stabilized Outlets BMP.

2. Heavy equipment should be well-maintained to prevent leaks.

3. Vehicles and other equipment should *not* be washed at locations where the runoff will flow directly into a watercourse or storm sewer.

4. Store, cover and isolate construction materials, including topsoil and chemicals, to prevent runoff of pollutants and contamination of groundwater, following the design guidance below.

5. A spill response plan should be developed which includes the procedures which will be taken in the case of a spill. This is discussed further in "Proper Storage, Use and Disposal of Chemicals," below.

6. A waste management plan should be developed. Empty canisters, cans or other chemical containers (i.e. from hydraulic fluids, etc.), scrap wood, scrap metal, and all other waste materials are to be disposed of daily or kept in sealed waste containers until they can be disposed of off-site in a landfill. Waste materials are *not* to be buried on-site.

7. Specific areas should also be designated and maintained for employee parking.

Equipment Maintenance and Storage in Structures (buildings):

1. All floor drains which discharge to storm sewers should be sealed/plugged. New floor drains should discharge to a sanitary sewer.

2. All floors should be constructed of cement or other impervious materials to prevent contaminants from leaching into the soils or groundwater.

3. Equipment wash areas should discharge into a sanitary sewer line. Depending on the amount of oil, grease and other pollutants, pre-treatment of wastewater may be needed before it enters the sanitary sewer.

4. Trucks and other equipment with large quantities of mud should be washed outside on designated wash areas, so as not to clog sanitary sewer lines.

Equipment Maintenance and Storage in Maintenance in Open Areas:

1. Ideally, all maintenance should be done on impervious areas surrounded with impervious berms. Where this is not possible, use pads designed to contain the pollutants which may leak or spill during maintenance operations. Impervious pads are particularly important on sandy and other course soils where spilled materials can easily leach into the groundwater.

2. Wash areas should be constructed out of 2-3" stone or other approved material, with a minimum 6-inch base. They should be underlain with geotextile materials, and protected using berms or Diversions to prevent the runoff water from leaving the site. See the Appendices for manufacturers of geotextile materials.

3. Equipment should never be stored within the drip line of trees.

4. Topsoil should be stored following specifications in the Spoil Piles BMP.

5. Follow the guidance below for the "Proper Storage, Use and Disposal of Chemicals."

Proper Storage, Use and Disposal of Chemicals:

1. Follow all federal, state and local laws regarding the storage of hazardous materials. In general:

   -All hazardous chemicals should be stored in sealed containers. Secondary containment should be incorporated into the design of the maintenance/storage facility to contain spills from all hazardous materials.

   -Pesticides should be stored according to the guidelines in the Pesticide Management BMP.

   -Keep labels on all products so that they are readable. Do not use a product without a label.

   -Maintain records of the use and application of all products stored on site.

   -Maintain proper ventilation. Post "no smoking" and other signs to warn of potential dangers. Keep the area locked.

2. Develop a spill response plan. This should include the steps that will be taken to contain and cleanup spills. All persons working with chemicals should be familiar with the spill response plan. For spills of hazardous materials which cannot be contained on-site, or when there is a known or potential impact to surface or ground water or soils, contact the Pollution Emergency Alert System (PEAS) line at 1-800-292-4706.

3. Absorbent materials such as hay bales, cat litter and absorbent pads should be kept on-site to prevent the migration of pollutants which are spilled on imperious areas.

4. Dispose of small quantities of material (i.e. less than 1 gallon) based on the type of pollutant absorbed:

   -Dispose of pesticides following specifications in the Pesticide Management BMP; and

   -Follow specifications in the Household Hazardous Waste Disposal BMP for small quantities of hazardous wastes (1 gallon or less);

   For other hazardous wastes, or wastes in excess of 1 gallon, contact the MDNR, Waste Management Division at 517-373-2843 for additional information.

5. Contact the MDNR, Environmental Response Division at 517-373-4823 for information on the Right-to-Know Law and for information on underground storage tanks.

Maintenance

Outside equipment/maintenance storage areas should be inspected daily to ensure equipment isn't being stored within the drip line of trees and to ensure the vehicles and equipment aren't leaking. Also make sure waste materials are being properly disposed of. Periodic checks of the equipment wash area should also be done to ensure it is not failing. Additional stone may be needed to maintain the wash area.

Ongoing maintenance of structural equipment maintenance/storage areas should include periodic inspections of the structure to check for cracks in the floor, and for other structural flaws. In existing buildings, be sure to inspect the floor drains to make sure they are not discharging to storm drains.

Additional Considerations

Draft revisions to Part 21 Rules of the Water Resources Commission (Act 245) will require construction permittees to provide facilities for containing any accidental losses of oil or other polluting substances, and comply with reporting procedures for on-land facilities under Part 5 rules. Approved equipment maintenance and storage areas must meet these Part 21 Rules.

Dec. 1. 1992

Slope/Shoreline Stabilization

Description

This BMP addresses structures which stabilize shorelines and slopes that cannot be stabilized with vegetation. Structures included in this BMP are: revetments, gabions, seawalls, bulkheads, groins, breakwaters and retaining walls. Typical applications of each of these structures are included in this BMP. Note that some of these structures are also used to stabilize stream banks. For additional information on these and other practices which can be used to stabilize stream banks, see the Stream Bank Stabilization BMP.

Permits for the construction of slope/shoreline stabilization practices will be required by the Department of Natural Resources, Land and Water Management Division if the structure is below the ordinary high water mark of a lake (or stream), floodplain or wetland. In some situations, both MDNR and U.S. Army Corps of Engineer permit requirements will need to be met.

Other Terms Used to Describe

Breakwalls
Bulkheads
Gabions
Groins
Retaining Walls
Revetments
Seawalls

Pollutants Controlled and Impacts

These practices protect the shorelines of watercourses by stabilizing embankments, thus limiting the erosion of soils and their associated particles into a watercourse.

Application

Land Use
This practice is applicable to all land uses.

Soil/Topography/Climate
The type of shoreline stabilization method used will vary depending upon the soils, slope of the land, groundwater characteristics, and the climatic conditions of the area. Their use is very important in areas where there are steep slopes, highly erodible soils, and where conditions can significantly increase or create erosion (i.e. areas of flash floods, strong winds and lake shorelines).

Special consideration should be given to the design and use of structures that will be susceptible to the forces of ice movement. Ice action has been shown to weaken, dislocate, and destroy improperly designed and installed structures.

When to Apply

Slope/shoreline stabilization structures should be installed prior to or immediately after disturbing erodible soils. Seasonal limitations exist for the construction of several of these structures, some of which are included in the specifications.

Where to Apply

Apply this BMP in areas where there is active or foreseeable erosion of the soils adjacent to a watercourse or wetland, and/or on steep slopes. Note that the construction and installation of these structures should not result in encroachment into the watercourse or wetland.

Relationship With Other BMPs

Areas up-slope of these structures should be stabilized with vegetation following the Seeding and Mulching or Sodding BMPs. In some instances, Diversions can be used to divert water away from these structures while they are being developed. Geotextile Filters are often used under these structures to filter sediment.

Specifications

General Considerations:

All slope/shoreline stabilization structures should be designed by licensed professional engineers, or other persons trained and experienced in their design.

1. All slope/shoreline stabilization structures should be free of sharp edges and protruding metals.

2. All structures require a site visit to determine the appropriate structure. During a site visit:
   - determine the soil texture and its inherent stability
   - determine the normal and storm surge water elevations
   - measure the length and (where appropriate) height of the area
   - consider the elevation of the proposed location for the new structure in comparison to the elevation of the existing shoreline

3. When designing structures, always try to follow the contour of the existing shoreline.

Revetments:

Revetments are stone, rock, interlocking blocks, gabions (see below), stacked bags (filled with sand or grout), or special mats, which are placed at the toe of a bluff to protect against storm/wave action. Revetments are cost effective, beneficial to the affected property owner, and do little or no harm to a lake environment *provided* the revetment material is clean, stable, and tied to existing structures and/or the shore.

General Considerations:

1. The three basic components of a revetment are the armor layer which absorbs the wave energy, the underlying filter layer supporting the armor layer, and the toe protection to prevent displacement of the armor units. All components should be designed simultaneously.

2. The stability of a revetment depends on the underlying soil conditions and should therefore be constructed on a stabilized slope. Erosion may continue or accelerate on an adjacent shore if it was formerly supplied with material eroded from the now protected area.

3. Slopes steeper than two horizontal to one vertical (2:1) are generally not suitable for revetments.

Design and Construction:

1. Riprap design and installation should be done following specifications in the Riprap BMP. Upon Department approval, consider installing fish habitat structures in conjunction with rock rip-rap to both stabilize an embankment and improve fish habitat.

2. Inter-locking blocks and honeycomb-shaped plastic sections which are backfilled with soil have been used successfully on steep slopes. The manufacturer's/suppliers listing in the Appendix of the "Guidebook to Best Management Practices for Construction Sites and Urban Areas" includes companies which carry these type of products.

Gabions:

Gabions are flexible woven-wire or plastic baskets composed of two to six rectangular cells filled with stone. They can be used in lakes and steep shorelines (or where river flow is such that riprap will not hold). The following is modified from "Guidelines for Soil Erosion and Sediment Control," Connecticut, 1985.

General Considerations:

Since gabions are used where erosion potential is high, construction must be sequenced so that the gabions are put in place with the minimum possible delay. Disturbance of areas where gabions are to be placed should be undertaken only when final preparation and placement of the gabions can follow immediately behind the initial disturbance. Always work at the low lake level (or low stream flow level).

Design:

Gabions may be used when all the following conditions are met:

a. The design storm, riprap size and location, filter and quality criteria for riprap are met.

b. The design water velocity does not extend beyond that given in Table 1, below.

Table 1

Design Water Velocity

Gabion Thickness (ft.)	Maximum Velocity* (ft./sec.)
1/2	6
3/4	11
1	14

*Maximum velocity is the velocity at the gabion (not, for example, the mean stream velocity.

Source: U.S. Department of Agriculture, Soil Conservation Service, Storrs, Connecticut.

c. The Manning's "n" value used for gabions shall be 0.025.

d. The pH of the soil and water is above 5, and the soil water resistivity is more than 4,000 ohms/cm, or plastic coated gabions shall be used.

e. A filter is required unless the gabion has a thickness of at least three times the D_{50} size of the rock used to fill the gabions.

f. The rock used to fill the gabions shall be larger than the gabion mesh opening.

g. Manufacturer's specifications are followed.

Construction:

1. Each gabion should be assembled by binding together all vertical edges with a continuous piece of connecting wire looped twice around the vertical edges with a coil approximately every four inches, except the mattress type where the coil should be approximately every three inches. Empty gabion units should be set to line and grade as shown on the plans. Connecting wire should be used to join the units together in the same manner as described above for assemble. Internal tie wires should be uniformly spaced and securely fastened in each outside cell of the structure. When gabions are being placed as slope protection or channel lining, the internal tie wires may be deleted.

2. Care should be taken when placing aggregate to assure that the sheathing on PVC-coated gabions will not be broken or damaged.

3. A standard fence stretcher, chain fall, or iron rod may be used to stretch the wire baskets and to maintain an alignment. After a gabion has been filled, the lid should be bent over until it meets the sides and edges. The lid should then be secured to the sides, ends and diaphragms with the connecting wire in the manner described above for assembling.

4. When the mattress type gabions are placed on 1.5:1 (or steeper) slope, steel stakes should be driven through the gabion along the top edge, as necessary, to hold the structure in place. Manufacturer's directions should be followed closely.

Seawalls and Bulkheads:

A seawall is a structure that is built to protect the landward side of a slope from damaging wave action or currents. Seawalls may be constructed with concrete, steel sheet piles or wood. Bulkheads have two functions. The first is to retain or prevent sliding of material seaward, and the second, to protect the upland against damage from wave action. The effects of seawalls and bulkheads on the entire reach of shoreline (or stream edge) must be evaluated.

General Considerations:

1. If the adjacent property has a seawall, a similar seawall in height and location should be used. It should tie into existing adjacent walls.

2. If the adjacent property is not seawalled, the proposed wall should tie into the shoreline and include tie backs into the upland. Tie backs should be riprapped at the shoreline to prevent erosion of adjacent properties.

Design:

1. The structure should be located and designed such that the structure will not create navigation safety hazards, debris traps, accelerated erosion of adjacent property, or any other problems.

2. The design should be appropriate for the site. Consider using materials similar to adjacent property owners. This will make the water line look more aesthetically pleasing.

3. Tie-backs must be designed to prevent erosion from water flow around the sides. Typical tie-backs extend 10 feet into the upland.

4. Bulkheads and seawalls that rise vertically well above a water or wetland surface may need to be equipped with ladders or escape measures in case of accidental falls by users.

Construction:

In general, for proper installation of steel or timber bulkheads, one-third of the wall should be above the lake bottom and two-thirds of the wall should be into the lake bottom.

Groins:

A groin is a shoreline protection structure which is usually situated perpendicular to the shore to trap soil for creating a beach on the up-drift side of the groin. These structures may consist of a single groin, or be combined with several groins to form a groin field. Careful design is needed to avoid adverse erosional effects on the down-drift side of a project.

General Considerations:

1. Groins by themselves will usually not provide adequate protection to the backshore area during a large storm. A wood retaining wall at the toe of the bluff may also be necessary to provide adequate protection.

2. Since groins may affect the "down-drift" area, the groin should be located and designed such that any erosion caused by the groin does not affect unprotected shoreline. Determine the new littoral transport direction by visual inspection of other groins in the vicinity, or review aerial photographs.

3. Spacing of groins depends on local wave energy and the amount of littoral drift. Groins should be spaced so that drift accumulates along the entire distance between the structures. (If the groins are too far apart, part of each compartment will be unprotected due to lack of accumulation. If the groins are too close together, not enough littoral material will accumulate in the compartments). As a rule of thumb, space groins from 1 - 1.5 times their effective length apart.

Design:

1. The proposed groin should not be longer than other groins in the vicinity.

2. Groins must be:
   - designed to cause the least damage to the down-drift side of the project
   - designed with no more than one foot above the current water level at the lakeward end
   - designed to extend into the face of the bluff or upland area
   - designed so that it is at least one-half of its length away from the property line. If this is not possible, then written consent must be obtained from the adjacent land owner.
   - constructed perpendicular to the shore

Groins constructed of wood or steel should extend 2/3 of the length of the material below the beach or lake bottom.

Construction:

Construction should be perpendicular to shore and should be done according to the design.

Breakwaters:

The function of breakwaters is to intercept incoming waves, dissipate their energy, and thus form a low-energy zone on the landward side. This reduction in wave energy reduces the ability of sediment transport. Sand moving along the shore is therefore trapped behind the structures and accumulated. Breakwaters are often placed as segmented structures that allow for the protection of longer reaches of shoreline for less cost.

Design:

The design and construction of breakwaters is usually done by or with the supervision of the U.S. Army Corps of Engineers.

Retaining Walls:

Retaining walls are used to stabilize steep slopes. They may made using riprap, railroad ties, gabions or other appropriate materials.

Maintenance

Annual inspections are important to check and re-align structures for functionability and safety. Check for hazardous materials or conditions which may have resulted from flooding, ice, or other weather conditions (i.e. look for sharp metal objects, signs of piping around structures, animal burrows, shifted and/or damaged materials within the structure, etc.).

Exhibits

Exhibit 1: Typical Revetment. Michigan Department of Natural Resources, Land and Water Management Division. Construction Project Evaluation Manual.

Exhibit 2: Gabions. Virginia Soil Erosion and Sediment Control Handbook. 1980.

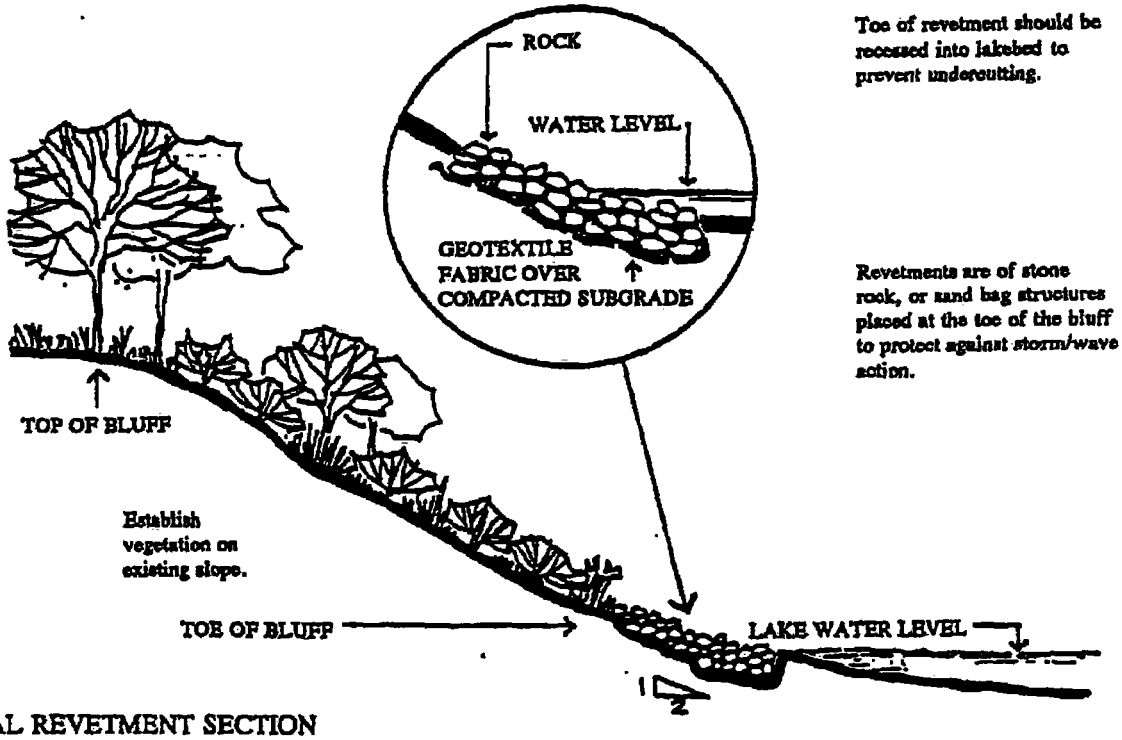
Exhibit 3: Seawalls: Four Situations and the Type of Structures Required. Michigan Department of Natural Resources, Land and Water Management Division. Construction Project Evaluation Manual.

Exhibit 4: Groins. Michigan Department of Natural Resources, Land and Water Management Division. Construction Project Evaluation Manual.

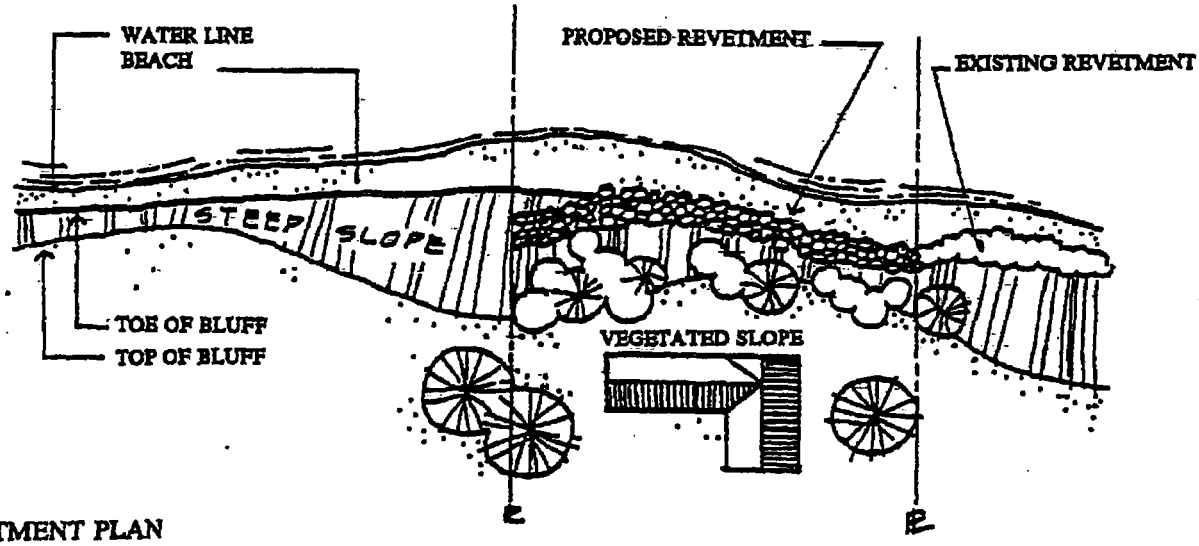
Exhibit 5: Retaining Wall. Michigan Soil Erosion and Sedimentation Control Guidebook. 1975.

Exhibit 1

Typical Revetment



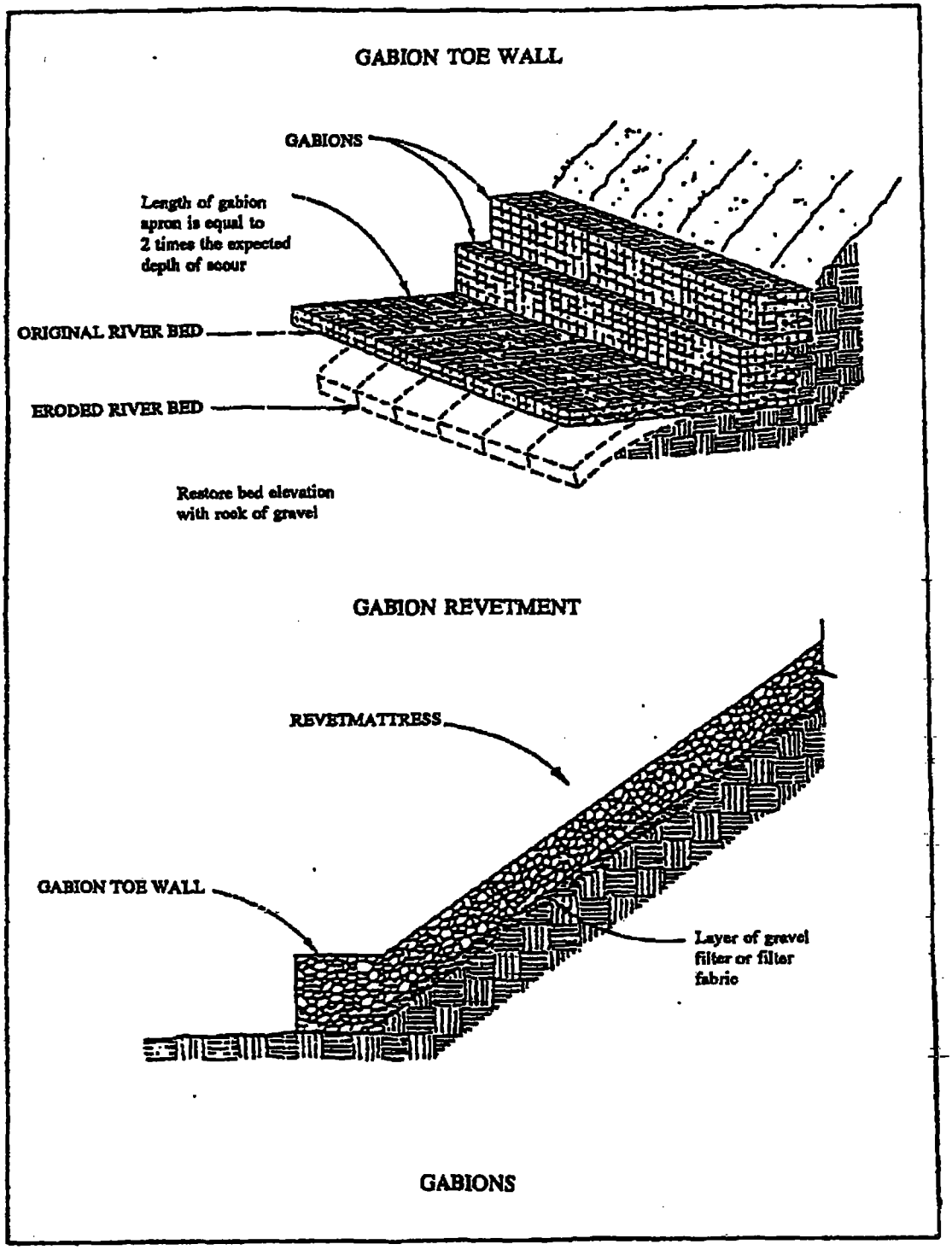
TYPICAL REVETMENT SECTION



REVETMENT PLAN

Source: Construction Project Evaluation Manual. MDNR, Land and Water Management Division.

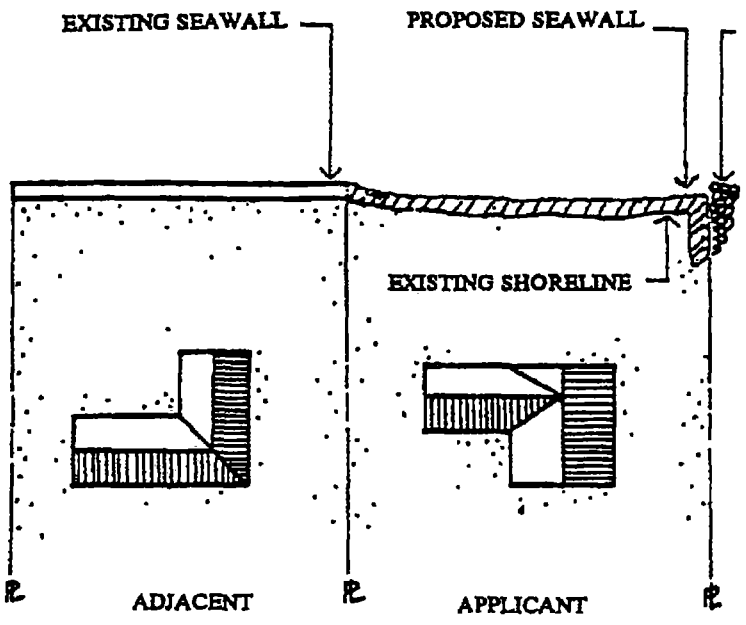
Exhibit 2
Gabions



Source: Virginia Soil Erosion and Sediment Control Handbook, 1980.

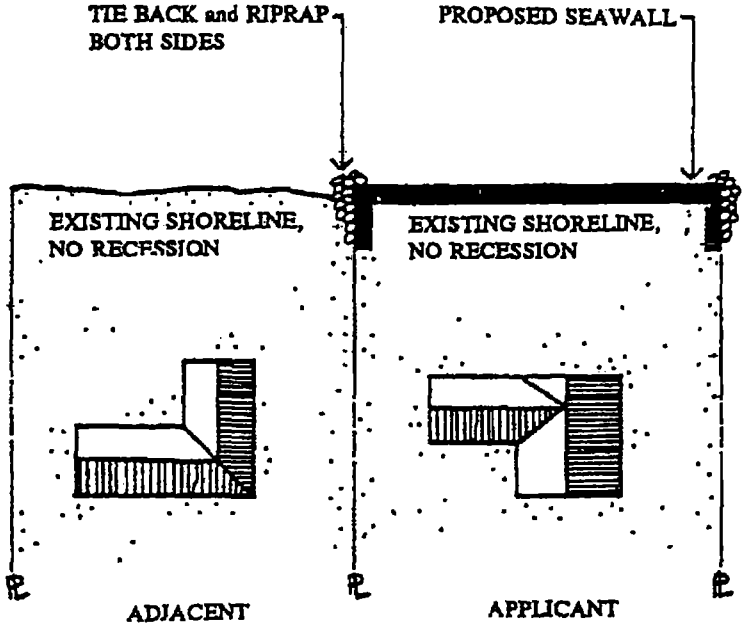
Exhibit 3

Seawalls: Four Situations and the Types of Structures Required



CONDITION ONE

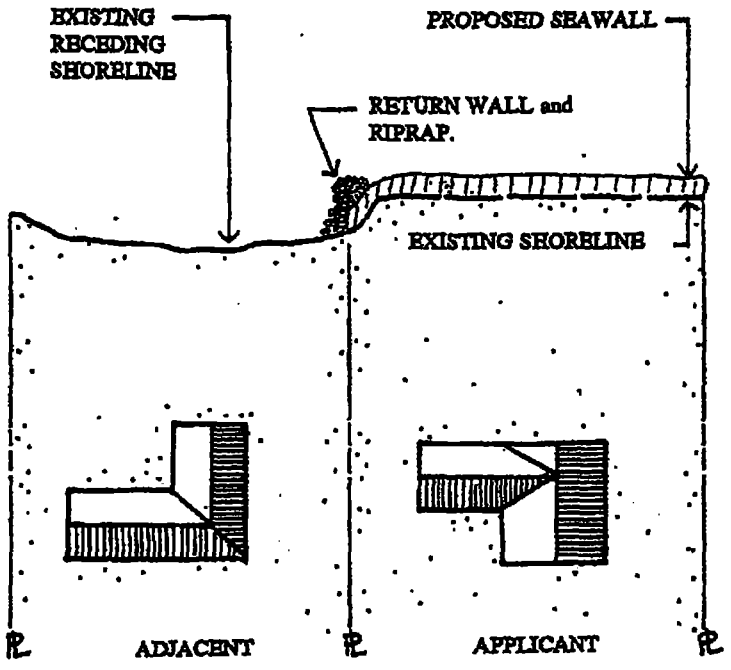
If adjacent shoreline has a seawall, a similar seawall in height and location should be used. Where possible, try to contour the new seawall with the existing shoreline, and use similar materials.



CONDITION TWO

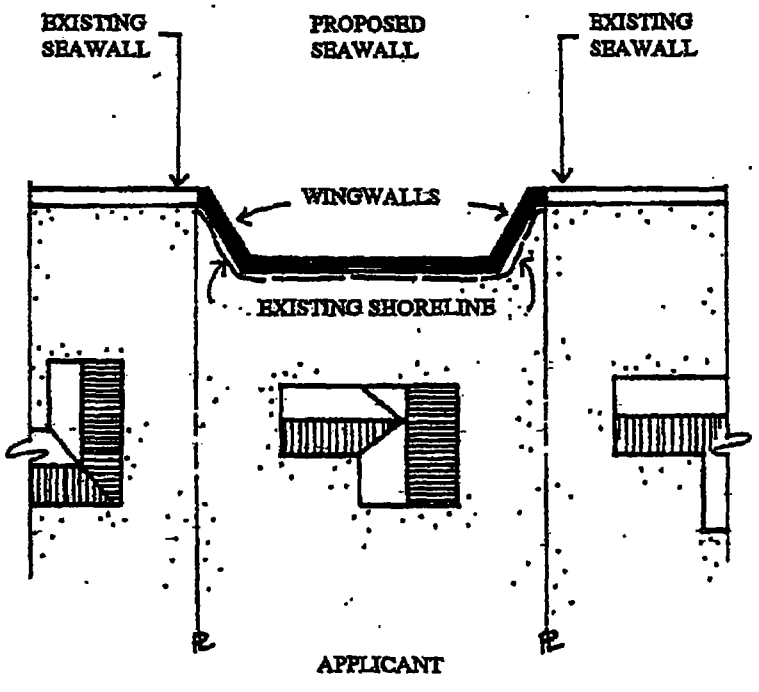
If adjacent shoreline has not recessed, a seawall parallel to the shoreline is required.

Exhibit 3 (Con't)



CONDITION THREE

If adjacent shoreline is recessed, a return wall is required.



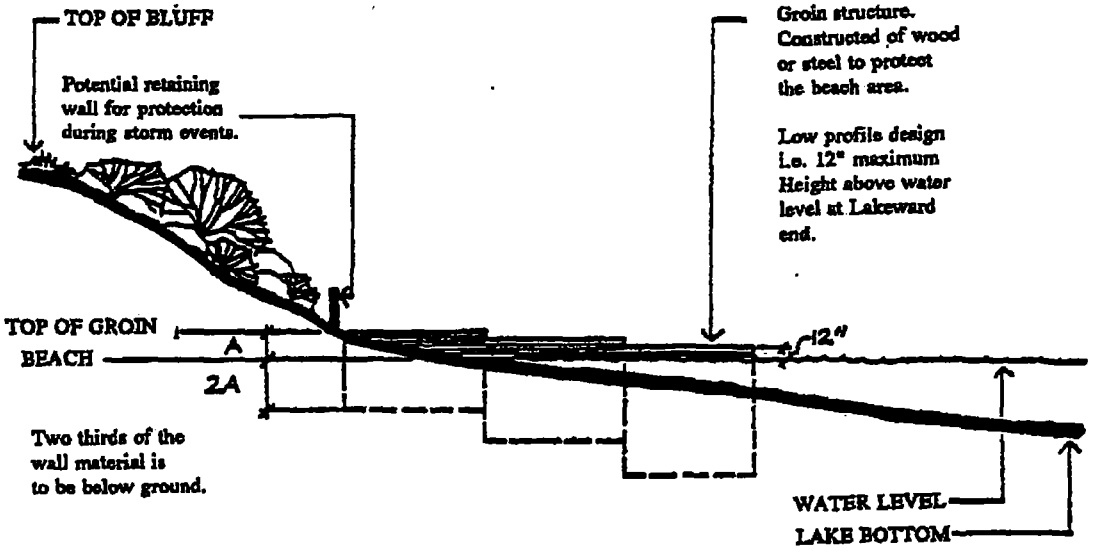
CONDITION FOUR

If adjacent shorelines have seawalls and existing shoreline has recessed significantly, a seawall with wingwalls is required.

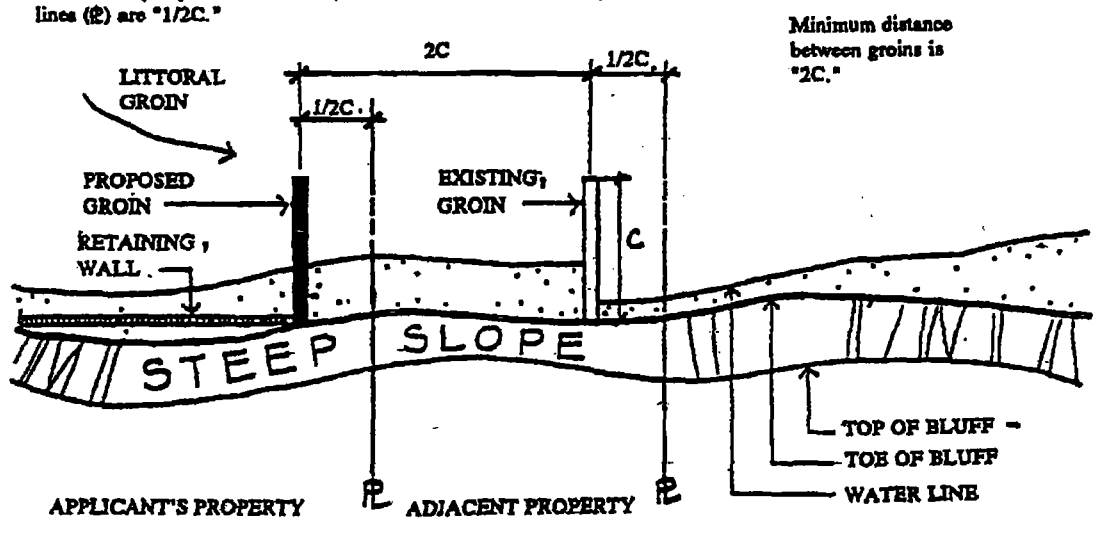
Source: Modified from the Construction Project Evaluation Manual, Michigan Department of Natural Resources, 1987.

Exhibit 4

Typical Groin



TYPICAL GROIN SECTION

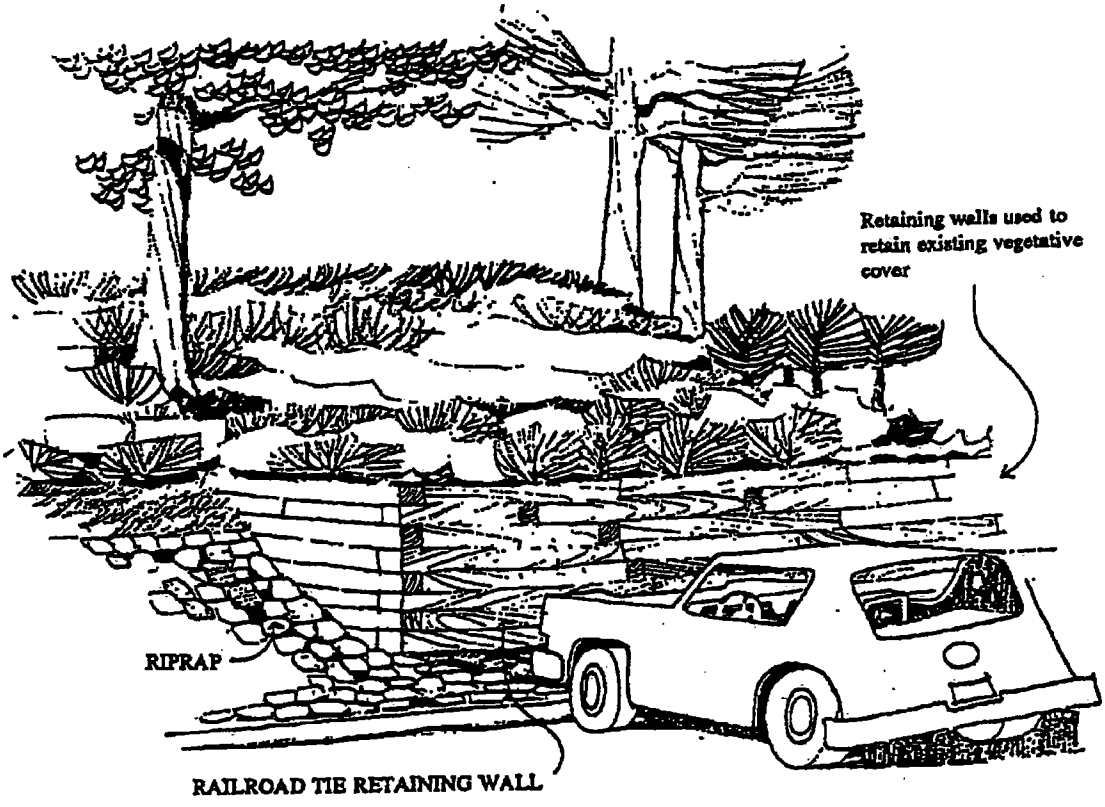


GROIN PLAN

Source: Construction Project Evaluation Manual, MDNR, Land and Water Management Division.

Exhibit 5

Retaining Wall



Source: Construction Project Evaluation Manual. MDNR, Land and Water Management Division.

Stream Bank Stabilization

updated September, 1997

Description

This BMP discusses the thought process that should be used when eroding stream banks are deemed in need of stabilization. Emphasis is placed on stabilization at the watershed level first, then individual sites. Several systems of BMPs are discussed, with reference to specific BMPs. Emphasis is given to "softer", less rigid structures.

In all aspects of stream bank erosion—from source and cause identification to design and implementation of BMPs—people are encouraged to work with Department of Environmental Quality (DEQ) Nonpoint Source staff in Surface Water Quality Division, or with other stream bank experts.

Note that all stream bank stabilization activities will require permits from the Department of Environmental Quality, Land and Water Management Division. For a discussion on the use of gabions, seawalls and retaining walls, groins, shoreline revetments, and breakwalls, see the Slope/Shoreline Stabilization BMP.

Other Terms Used to Describe

Armoring
Revetments
Riprapping (Note that Riprap is a separate BMP)
Soil Bioengineering/Bioengineering
Stream Bank Protection

Pollutants Controlled and Impacts

Stabilizing stream banks can:

* Prevent the loss of land or damage to utilities, roads, buildings or other facilities adjacent to a watercourse, and prevent the loss of stream bank vegetation,
* Reduce sediment loads to streams,
* Maintain the capacity of the stream channel,
* Improve the stream for recreational use or as habitat for fish and wildlife, and
* Control unwanted meander of a river or stream.

Application

Land Use

This practice is applicable to all land uses.

Soil/Topography/Climate

The site-specific stream bank practices used will be partially dependent upon the types of soils present, the slope of the bank, gradient of the river, flow, and uses of the watercourse.

When to Apply

The appropriate time to apply stream bank erosion controls is dependent upon the method used. Some seasonal limitations are included in the specifications of referenced BMPs.

Where to Apply
Apply this practice in areas where stream banks are eroding.

Relationship With Other BMPs

Geotextile materials (Filters) are often used underneath Riprap.

Specifications

Since each reach of a watercourse is unique, stream bank protection techniques must be selected on a site-by-site basis; the specifications for each technique differ. The following is guidance which can be used to determine appropriate stream bank erosion control practices.

Planning Considerations:
It is important to remember that streams are dynamic. Even without human influence streams may meander, and in the process, cause banks to erode. Therefore, not all eroding banks are "bad" and in need of repair. In fact, the wrong system of BMPs installed in the wrong place may cause more damage downstream (and therefore to the entire stream system) than leaving the stream in its natural state. For example, "hard structures" like large riprap or gabions, placed on one eroding bank, can displace the stream's energy downstream to a previously stable bank, causing the downstream bank to erode. If this downstream bank is also stabilized with a hard structure, the stream's energy may be moved further downstream to another previously stable bank, and so on.

So before stabilizing stream banks, consider the cause of the stream bank erosion. If the banks are eroding due to a natural meander, then it may be best to leave the bank alone. If the banks are eroding due to fluctuations in hydrology, the hydrologic fluctuations should be addressed before the banks are stabilized.

Once the cause of erosion is addressed, determine the goal in stabilizing the stream banks. Some banks are stabilized to protect buildings and land. Others are stabilized to keep soil from entering the stream and to allow angler access to the stream. The purpose for stabilizing the banks and the users of the stream will help determine the type of structures needed.

Once the above concerns have been addressed, then it is important to work with agencies with expertise in stream bank erosion techniques to address stream bank erosion at the watershed level. Looking at the entire watershed will help prioritize bank stabilization efforts. If you are only interested in site-specific alternatives, please turn to "Methods" on page 5.

1) compile land use data on the watershed to determine if there is a direct link between land use and soil erosion. For example, land in livestock production can be a source of sediment if the livestock have direct access to the stream. If land uses are being converted from agriculture to urban, the increased impervious areas may cause increased flows to the stream, which may scour stream banks and cause erosion. Put simply, land uses can help pinpoint potential sources of erosion.

The DEQ, Land and Water Management Division's Michigan Resource Information System (MIRIS) database contains information on the soils, land uses, streams, roads and other features in watersheds throughout the state. Keep in mind that as of the date of this printing, MIRIS data was based mostly on 1978 land use data. Many Soil Conservation District offices also have land use data (often based in part on the MIRIS). Several universities have sophisticated land use decision-making ca-

pabilities (which may include MIRIS data), as well as the capabilities to determine future land uses based on current trends.

Other important sources of land use information include topographic maps of the area, soil maps (if available), and aerial photos. These will show the pattern of the river as it meanders through the watershed. Comparing recent aerial photos to historic photos will also help determine if the river is widening, meandering or otherwise in a state of change.

2) Field verify the data. Because land uses change, it is important to field verify land use data in order to ensure decisions are made based on current and accurate information. This is particularly important in rapidly developing areas. Field verify data by walking or canoeing the entire river, or, if granted permission by property owners, by walking the stream banks. If you're not familiar with the river or stream, contact the DEQ, Surface Water Quality Division or Land and Water Management Division, or DNR, Fisheries Division to find out if the stream is wadable. In National Forest Service lands, contact the US Forest Service. These and other agencies will likely have some information on the stream you're interested in.

When you go out in the field, take a measuring tape, clipboard, pencil or waterproof pen, and multiple copies of the attached worksheet (Exhibit 1). A camera is also important when discussing site-specific conditions with other people. On wadable streams, take hip boots or waders. Use the attached worksheet while noting the specific areas of stream bank erosion. Note soil type and any log jams, construction activities, eroding road crossings, and improper stream access (e.g. cows in the water, areas where people have accessed the river for recreational opportunities, etc.). Where possible, measure the length and height of the eroded stream banks.

Back in the office, incorporate your visual observations with the land use data. Ideally, this will be done by incorporating your notes into the land use database.

3) Estimate the magnitude of the erosion and all potential sources of erosion. Sources of sediment to the stream may include angler access, livestock access, or poorly maintained or improperly designed road crossings. The magnitude of the erosion can be determined by ranking each site as severe, moderate or minor, using the attached field sheet (Exhibit 1). Use of the Universal Soil Loss Equation is discussed in an appendix of the Guidebook of BMPs.

4) Rank the sites. At its simplest, ranking sites can be based on addressing the most severe sites first and working from upstream to downstream, including tributaries. Another alternative is to rank sites based on four criteria: 1) degree of impact (severe, moderate, minor); 2) the cost of installing the system of BMPs needed; 3) landowner willingness to cooperate; and 4) "demonstration-ability." (i.e. amount of public visibility). "Demonstration-ability" is important if you plan to solicit volunteers or funding for stabilization efforts. This site ranking method was used in the Bear Creek watershed, Kent County.

5) Determine appropriate options for the high priority sites. Use the information gathered on land use and from visual observations (including photos) to evaluate stream bank stabilization alternatives. The BMPs selected should also help to achieve the overall goals for the watershed (such as improving fish habitat or providing greater recreational access). Review the scenarios below, the various Methods on page 5, and then contact stream bank experts to discuss site-specific options.

Stream Bank Stabilization Scenarios:
The following hypothetical scenarios illustrate various alternatives for stream bank stabilization:

Scenario 1: Visual observations show several minor stream bank erosion sites. Erosion was determined to be caused by stream flow. The amount of human influence on flow is low (i.e. it is naturally "flashy" versus flashiness caused by increased flow from urbanization). The decision in this case is to leave the eroding banks alone.

Scenario 2: Comparing aerial photos from 1938 and 1990 shows that the stream hasn't meandered much, yet there are hundreds of banks along the stream that are bare, mostly due to angler and canoeist access. The stream is a high quality trout stream and local people hold the river in high esteem. Since sediment is detrimental to trout habitat, the decision was made to stabilize stream banks in this watershed, providing access via stairways and canoe landings, and restricting access via practices such as fencing and brush mulch. Since the greatest reduction in sediment load will be gained by stabilizing severe sites, the most severe banks will be stabilized first, going from upstream areas, downstream. If more money becomes available, then moderate sites would be stabilized, again, starting upstream.

Scenario 3: The predominant land use is urban. Severe erosion is observed downstream of the urban area. In this hydrologically unstable area a stormwater management plan will be developed in conjunction with or prior to stream bank stabilization to reduce extreme hydrologic fluctuation and velocities. In this example, the decision was also made to work on an ordinance which would address stormwater practices to prevent additional flows to the stream.

Scenario 4: The predominant land use is agricultural. Moderate and severe bank erosion is occurring at several livestock access areas. In this example, cattle exclusion systems, including fencing and alternative watering areas, were designed and implemented in conjunction with stream bank stabilization techniques.

Scenario 5: Visual observations and historical aerial photographs show the stream to be relatively stable. Most of the adjoining land is rural/agricultural but is expected to experience 35% growth in the next 15 years: therefore, additional flows to the stream are expected. Two new road crossings are causing severe erosion downstream of the crossings. The decision was made to stabilize the banks downstream of the new crossings with structures which help absorb some of the energy from stream flow (see soil bioengineering structures, below). The decision was also made to work with the road commission so that future road designs would be done such that downstream areas are not impacted. An ordinance to provide on-site detention/retention of stormwater from the newly constructed area was also proposed.

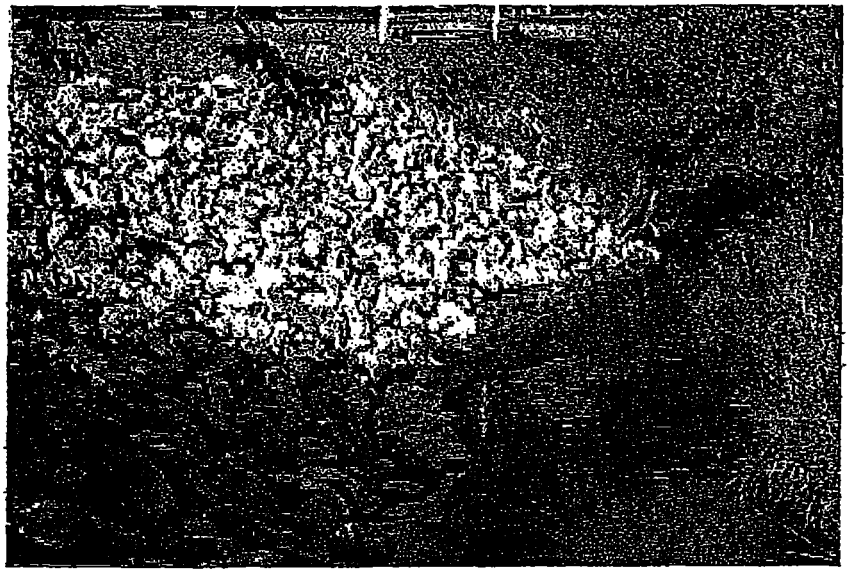
Other Things to Consider
In selecting site-specific options to stabilize eroding stream banks, consult the Michigan Department of Environmental Quality (Surface Water Quality Division or Land and Water Management Division), local Conservation District, or other agencies or consultants experienced in stream bank erosion control. Also, be sure to check Exhibit 2 to see if your river is included on the list of Natural or Wild and Scenic Rivers. These rivers have special restrictions, depending on their designation. Contact the MDEQ, Natural Rivers Program staff for further information on the types of stream bank practices that can be used in Natural Rivers.

It is also important to get input from the people who may use the watercourse at the specific site in need of stabilization, (i.e. river boat guides, anglers, canoeists, etc.). Consider working through a local watershed steering committee, if available. These committees include representatives from a variety of backgrounds and interests.

NOTE: While considering BMP options, remember that no removal of sediment bars, snags, stumps, debris drifts, trees, brush or similar material should be done unless absolutely necessary, and upon approval by the MDEQ, Land and Water Management Division. This in-stream cover is necessary for channel diversity and aquatic habitat.

Methods:
There are numerous methods available to stabilize stream banks. Rather than discuss all of them or any of them in detail, below is a discussion of the most common practices.

Riprap:
Riprap is one of the more commonly used stream bank stabilization techniques. It is a permanent cover of rock used to stabilize stream banks, provide in-stream channel stability, and provide a stabilized outlet below concentrated flows. It is generally used on stream banks at the toe (bottom) of the slope, with other structures placed up-slope to prevent soil movement. It is often a component of many soil bioengineering techniques. Specifications for riprap used in stream bank stabilization is discussed in the Riprap BMP.



Picture 1, above: The bank was stabilized with rock riprap from the toe (bottom) of the bank to the top of bank. This may be needed on streams with unstable hydrology (i.e. "flashy" streams), and where banks have groundwater seeps. Source: North Branch Chippewa River Nonpoint Source Project.

The Department supports the use of natural fieldstone for riprap; only natural fieldstone is allowed in rivers designated under the Natural Rivers program. The use of vegetation in conjunction with riprap is encouraged to "soften" stream bank structures.

Picture 2, right: Riprap was placed to 3 feet above the ordinary high water mark and a portion back-filled with soil. Log terraces were placed on the bank and the bank was seeded. This approach can be used on top of fish lunker structures and on banks where stream flows are relatively stable. Also note the fence and stairway to direct recreationist access. Source: Boardman River Nonpoint Source Project.

Soil Bioengineering:
Soil bioengineering is a method of using vegetation to stabilize a site with or without structural controls. Some refer to bioengineering as softening the traditional rock-the-bank approach because non-invasive vegetation is used to blend the site into its surrounding landscape. Bioengineering techniques may be as simple as using stop-logs to form terraces, then seeding exposed soil to help prevent soil movement. Techniques also include using fascines (long bundles of willow or dogwood), with layers of brush, along with individual plantings.

Picture 3, left, shows a fascine, brush layering and live stakes. **Picture 4, below,** shows new growth from a live stake. Source: Whetstone Creek Nonpoint Source Watershed Project.

Chapter 18 of the USDA Soil Conservation Service (now Natural Resource Conservation Service (NRCS)) Engineering Field Handbook is one of the most comprehensive sources of information on soil bioengineering. Chapter 18 describes soil bioengineering as a combination of biological and ecological concepts to arrest and prevent shallow slope failures and erosion. Rather than duplicate NRCS' efforts to describe soil bioengineering techniques here, people interested in exploring soil bioengineering are encouraged to work with the NRCS, MDEQ, and other agency staff familiar with bioengineering practices.

As another example of a system of practices used to stabilize a bank, refer to Picture 2. In addition to riprap, seed and log terraces, the system of BMPs on the bank in Picture 2 included fencing to direct foot traffict, and a set of stairs.

Maintenance

A maintenance plan should be included with all site plans. The maintenance plan should indicate when inspections of the site will be made and who will be responsible for needed maintenance. Site inspections, conducted to ensure the stream bank structures are staying in place, are particularly important within the first few months of installation, and following storm events which result in bankfull streams. More specific maintenance procedures can be found in the referenced BMPs.

Exhibits

Exhibit 1: Field Data-Entry Form which can be used in the stream bank erosion inventory, Northwest RC&D Council. (This type of approach has been used to identify and rank eroding sites on the Muskegon, Au Sable, Pine and Betsie Rivers).

Exhibit 2: Michigan's Natural Rivers System. List of rivers designated or proposed under the Natural Rivers program.

Field Data-Entry Form for Stream Bank Erosion Inventory

This form is intended to be used to compare the severity of eroding stream banks within a watershed. Results can be used to help prioritize stream bank stabilization efforts. Fill in all known information. Where provided, fill in the appropriate number per each category, then total the "points" on the last page.

Date: _____
County: _____
Stream: _____
Observer: _____

SITE LOCATION:
Township Name: _____ No. _____ Range ____ Sec. ____
Bank (right or left, looking downstream): _____
Property Owners: _____
Other info re: location: _____
Accessibility for machinery/materials (good/bad)
Access Problems:_____

SITE NUMBER: _____

MEAN WIDTH OF RIVER: _____
(no points)

CONDITION OF BANK:

	5	Toe and upper bank eroding
	3	Toe undercutting
_____	1	Toe stable, upper bank eroding
	5	Length of eroding bank > 50 ft.
	3	Length of eroding bank 20-50 ft.
_____	1	Length of eroding bank < 20 ft.
	5	Side slope vertical 1:1
	3	Side slope 2:1, 3:1
_____	1	Side slope 4:1 or flatter

PROBLEM TREND

	5	Increasing
_____	1	Decreasing or stable

(continued, next page)

DEPTH OF RIVER

	1	> 3 feet
_____	2	< 3 feet

VEGETATIVE COVER

	5	Vegetative cover 0-50%
	3	Vegetative cover 50-80%
_____	1	Vegetative cover 80-100%

MEAN HEIGHT OF BANK

	5	Mean height of bank > 20 ft.
	3	Mean height of bank 10-20 ft.
_____	1	Mean height of bank < 10 ft.

SOIL TYPE OR TEXTURE

	3	Sand
	2	Gravel
	2	Stratified
_____	1	Clay or loam

APPARENT CAUSE OF EROSION

	1-Light access traffic
	1-Obstruction in river
	1-Bank seepage
	1-Gullying by side channels
	2-Bend in river
	3-Road-stream crossing, grade/shoulder runoff
	3-Moderate access traffic
	5-Heavy access (foot, horse, etc.) traffic
_____	5-Construction site erosion

_____	TOTAL POINTS:	more than 36 — severe 30-36 — moderate less than 30 — minor

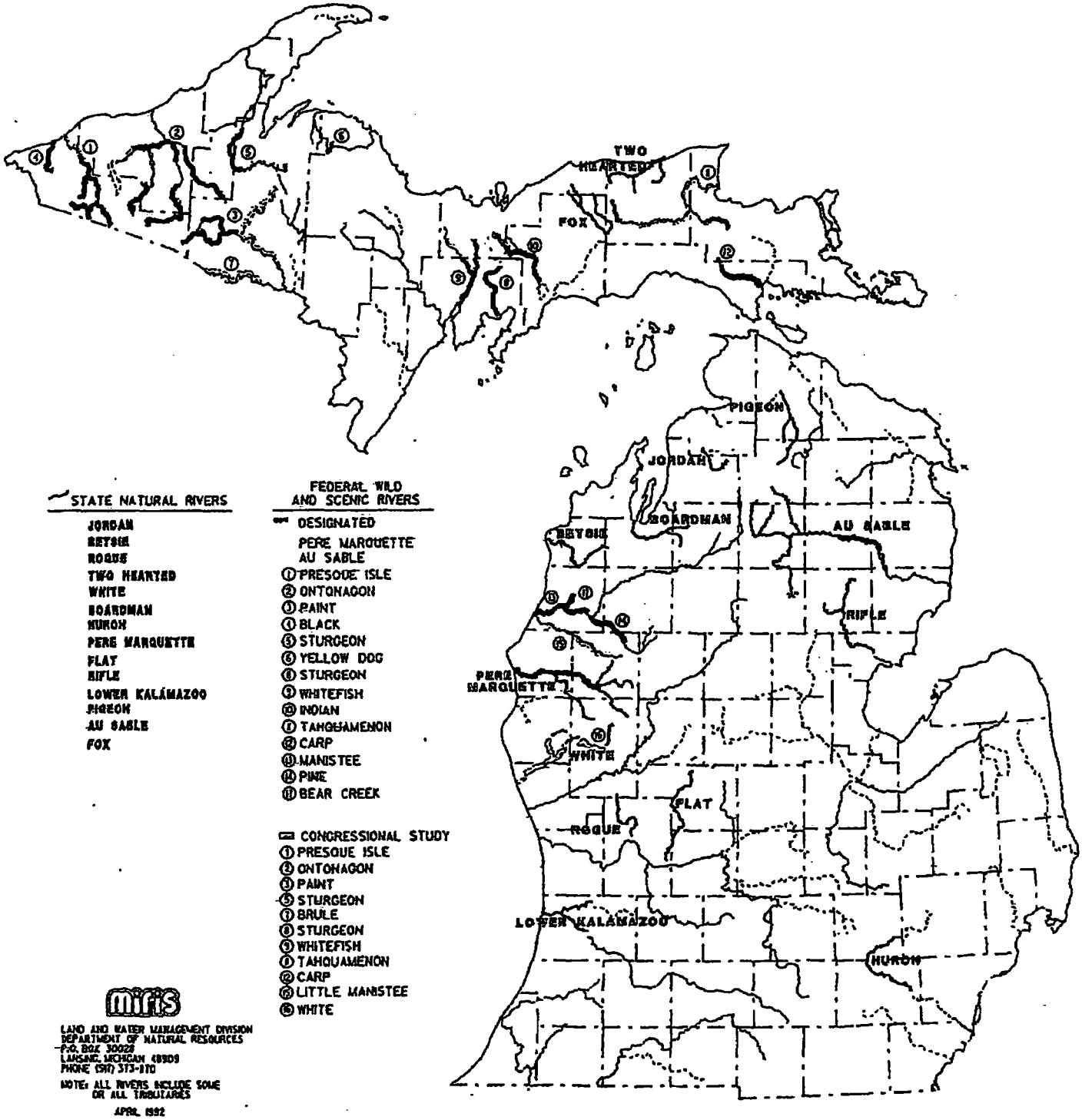
RECOMMENDED TREATMENT
Describe a potential system of BMPs for the site:

NOTE: Sketch location on a separate sheet, showing any unusual circumstances. Also, provide black-and-white or color photograph, if possible.

Source: Modified from the inventory sheet used in the Upper Manistee Stream Bank Erosion Inventory.

Exhibit 2

Michigan's Natural Rivers



STATE NATURAL RIVERS

- JORDAN
- BETSIE
- ROGUE
- TWO HEARTED
- WHITE
- BOARDMAN
- HURON
- PERE MARQUETTE
- FLAT
- RIFLE
- LOWER KALAMAZOO
- PIGEON
- AU SABLE
- FOX

FEDERAL WILD AND SCENIC RIVERS

DESIGNATED

PERE MARQUETTE
AU SABLE
① PRESQUE ISLE
② ONTONAGON
③ PAINT
④ BLACK
⑤ STURGEON
⑥ YELLOW DOG
⑦ STURGEON
⑨ WHITEFISH
⑩ INDIAN
⑪ TAHQUAMENON
⑫ CARP
⑬ MANISTEE
⑭ PINE
⑰ BEAR CREEK

CONGRESSIONAL STUDY

① PRESQUE ISLE
② ONTONAGON
③ PAINT
⑤ STURGEON
⑦ BRULE
⑧ STURGEON
⑨ WHITEFISH
⑪ TAHQUAMENON
⑫ CARP
⑮ LITTLE MANISTEE
⑯ WHITE

LAND AND WATER MANAGEMENT DIVISION
DEPARTMENT OF NATURAL RESOURCES
P.O. BOX 30028
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NOTE: ALL RIVERS INCLUDE SOME OR ALL TRIBUTARIES

APRIL 1992

Dewatering

Description

Dewatering is the removal of ground or surface water from a construction site to allow construction to be done "in the dry" (as opposed to under wet conditions). Water is usually removed using well points and power driven pumps. Dewatering of cofferdams and trenches is a common practice during the construction of bridges, culverts and public utilities (see the Watercourse Crossings BMP).

Other Terms Used to Describe

Pumping

Pollutants Controlled and Impacts

Proper dewatering techniques will filter water of sediment, oils, and other chemicals, thus preventing these pollutants from entering the surface waters.

Application

Land Use
Transportation (highway construction), urban (utility construction, and commercial development), and construction sites.

Soil/Topography/Climate
Dewatering is important in areas that have high ground water tables, or which do not have adequate drainage.

When to Apply
Apply at the beginning of and during construction when it is necessary to lower the ground water table. Pumping needs to be maintained to keep utility ditches and cofferdams dry until all underground work is completed.

Where to Apply
Apply on construction sites, where appropriate, or anywhere else dewatering is done.

Relationship With Other BMPs

Dewatering is often implemented in conjunction with Watercourse Crossings. Sediment Basins and Filters should be considered to help filter the dewatered water before it is discharged to a surface water.

Specifications

1. Dewatering must be done so that the velocity of the discharged water doesn't cause scouring of the receiving area. If the receiving area is a structural BMP (i.e. basin or sump), the design of the BMP should be based on the anticipated flow from the dewatered area.

2. Sediment-laden water from cofferdams, trenches and other areas which need to be dewatered, should be pumped through a geotextile material before the water is discharged to a watercourse. See the Filters BMP. The filter bag should be disposed of by the contractor at an upland site.

3. If the dewatered water is discharged through a filter to a county or inter county drain, permission must be obtained from the drain commissioner or drain board.

Maintenance

The dewatering site should be inspected several times daily to ensure that the pumping procedure is adequately controlling the excess water, to ensure the filter bag is not clogged, and that the vegetative filter, where used, is still retaining sediment. If the filter bag becomes clogged, replace with a new one. If sediment basins are used, be sure to follow maintenance procedures included in the Sediment Basin BMP.

Dec. 1, 1992

Mulching

Definition

Mulching is the process of placing a uniform layer of straw, wood fiber, wood chips or other acceptable materials over a seeded area to allow immediate protection of the seed bed. Mulch offers a moist, shaded growing zone which reduces plant burn-off. The proper and timely application of mulch can save entire seeded areas and minimize the amount of raw soil exposed to the elements. This BMP includes the use of erosion control blankets.

Mulch is also used for temporary stabilization of exposed soils which have not been seeded.

Pollutants Controlled and Impacts

Mulching done as a part of vegetative establishment will help keep soil particles and their associated attached chemicals (including phosphorus and pesticides) from entering surface waters. Mulch will also help suppress weed growth, provide a moist area for vegetative growth, reduce evaporation, and prevent crusting and sealing of the soil surface.

Application

Land Use
This BMP applies to any and all areas made bare of vegetation, either by human-induced or natural forces.

Soil/Topography/Climate
Although this practice should be used on all seeded areas, it is especially important on sloping or hilly terrain, and on wind-erodible soils.

When to Apply
Mulch should be applied immediately after each small segment of the area is seeded. Mulch may also be placed as temporary erosion control on exposed areas, and is especially important on exposed areas adjacent to streams and wetlands. Anchoring of the mulch should be done immediately after the mulch is applied.

Where to Apply
Mulch is necessary:

-on new seedings used to stabilize raw areas, especially slopes, droughty sands, and clayey soils

-on unseeded raw areas which need temporary protection from wind or rain

-on any other areas subject to erosion

Relationship With Other BMPs

To ensure an area has a strong vegetative cover, mulching should be done in conjunction with proper Seeding, Soil Management, Fertilizer Management and Grading Practices.
Concentrated flows should be directed away from mulched areas following specifications in the Diversions BMP.

Specifications

Mulch should be applied immediately after seeding has occurred.

Planning Considerations:

1. All seeded areas (see Seeding BMP) should be mulched using one of the mulching techniques below. Hydroseeding is discussed in the Seeding BMP.

2. Organic mulches are more effective and less likely to impact the environment than manufactured mulches, and are therefore recommended for most uses.

3. Choose from the following types of mulch. Application rates are given for each type of mulch.

   Straw. Straw is the most commonly used type of mulch, is readily available in most areas, and is effective when applied properly. Use small grain straw (wheat or oat) that is reasonably free of grain and weed seeds or mold. Straw of winter rye is preferable to spring-seeded grains, since fewer weed seeds generally are present. On critically eroding areas, spread uniformly at the rate of 2.5 to 3 tons per acre (2-3 bales per 1,000 square feet). Under normal applications, use 1.5 to 2 tons per acre. Hay should only be used if straw is not available.

   Straw rates for hydroseeding operations should be 2 tons/acre for most applications, and 3 tons/acre for dormant seeding.

   Straw Mulch Blankets. Straw mulch blankets should be made of a uniform layer of straw and should have a net covering on only one side. The straw and net should be securely stitched together to create a uniform mat. The straw should be clean wheat straw free of weeds and weed seeds. All components, including the stitching, should break down within the first growing season after placement.

   Excelsior Blankets. Excelsior blankets are made up of coarse wood fibers reinforced by netting. They are most commonly used in drainageways and other critical areas which will be exposed to concentrated flows during storms. The excelsior should consist of evenly distributed wood fibers. The top of the blanket should be covered with netting.

   Blankets should be applied with the netting side of the blanket on the top side (i.e. exposed). Lay the downstream or down-slope blankets first, working upstream or up-slope. Follow manufacturer's specifications.

   Where more than one width is required, and on ends, provide a minimum 4-inch overlap (or

more based on the manufacturer's recommendations). Blankets should be secured with U-shaped wire staples of a size and length suited to the soil condition. Follow the manufacturer's specifications. Apply fertilizer and seed before the blankets are laid.

Wood Chips. Wood chips are suitable for areas which will not be mowed, and around landscaped areas. Wood chips should not be used in areas which are drained by storm sewers, areas subject to flooding, or any other place where they would cause problems if they floated away.

Wood chips do not require anchoring, but need to be applied evenly to be effective as an erosion control measure. Ten or more tons of wood chips per acre should be applied. (The average weight per cubic yard is about 400 pounds. Thus, about 5 cubic yards equals 1 ton.) Several sources recommend applying nitrogen (N) when wood chips are used, in order to have N available for plant growth. If grass doesn't grow without N applications, apply 10-12 lbs. of N per ton of mulch.

Bark Chips and Shredded Bark. Bark chips and shredded bark are bi-products of timber processing and are often used in landscaping. They may also serve as mulch for areas planted to grasses which are not mowed, and on slopes which are not steep. Apply with a blower. Bark chips and shredded bark do not require nitrogen applications, and are less likely to leave the site than wood chips (because of their rough edges).

Compost. Compost (humus) can be used as mulch. See the Organic Debris Disposal BMP.

Note that the mulching application rates given above can be increased for dormant seeding.

Note also that wood materials should be fairly fine-textured when spread over seed.

4. **Anchoring should be done at the time of or immediately following the application of the mulch.** The appropriate type is dependent upon the type of mulch selected:

Mulch Blankets.
Below are some generic types of mulch blankets, (also called nets and mats) which are effective in preventing erosion on both raw and seeded areas. Their specific applications differ depending on the soil type and the slope of the area being protected. See the attached exhibit for additional information on installing and stapling blankets.

a. Mulch netting. This is a light-weight, fibrous material used to secure straw mulch where heavy flow is expected (i.e. in waterways and on steep slopes). Except when wood fiber slurry is used, the netting should be rolled on top of the mulch and secured to the ground with metal pins or wooden stakes. Wood fiber may be sprayed on top of an installed net. In areas which will be regularly mowed, netting may not be recommended. Use bio- or photo-degradable products.

b. Mulch with netting in combination. Several manufacturers make rolls of mulches bound on either side by netting. Because the mulch and netting are in one roll, installation is much easier than applying mulch and then securing a netting in a separate step. These must be anchored with staples or wooden pegs.

c. Mulch, netting and seed in combination. Some manufacturers also make rolls of mulch bound on either side by netting, with seed mixed in. This would allow the user to merely prepare the seedbed and install the blanket. These must also be anchored with staples or wooden pegs.

All mulch nettings should be made of a polypropylene mesh that will gradually decompose with exposure to sunlight.

Recycled Newsprint. Recycled newspapers should consist of a minimum 96% shredded high-grade newsprint fibers with a maximum 8% moisture context. The recycled newsprint should consist of a wetting agent, defoaming agent, and non-toxic dyestuff that will impart a bright green color. The dyestuff should adhere tightly to the fiber to minimize leaching of the dye after application. The mulch should contain a minimum 0.8 percent by weight of guargum tackifier. This material should come packaged in a waterproof material so it may by stored outside.

Application: Apply recycled newsprint mulch at a rate of 750 lbs/acre, placed over the straw mulch.

Mulch Crimper. This consists of a series of flat, notched discs that punch the mulch into the soil. Crimping is usually done on straw. When pulled over the mulch, the crimper punches some of the mulch into the soil.

Application: To use the crimper, the soil must be moist, free of stones, and loose enough to permit disc penetration to a depth of 3 inches. When using a crimper, seed and mulch by working across the slope. This method is limited to slopes where equipment can operate safely.

Emulsified Asphalt. This is a liquid chemical that has been used as a mulch binder. We do not recommend its use because: of the potential for the chemical to drift; it forms a fairly impenetrable layer; and it is sticky and therefore a potential nuisance to children.

Implementation:

1. Follow seedbed preparation in the Seeding BMP. Add any needed lime or fertilizer based on the results of soil tests. (See the Soil Management BMP).

2. Apply the seed before mulching except when the seed is applied as part of a hydroseeder slurry containing wood fiber mulch, or when a mulch blanket is used which already contains seed.

3. Apply the mulch uniformly according to the rates determined above. In hydroseeding operations, a green dye added to the slurry assures a uniform application.

4. Secure the mulch using the anchoring method selected above.

Maintenance

Mulched areas should be checked following each rain to ensure the mulch is staying in place. Additional tacking materials or netting may need to be applied to hold the mulch in place.

Maintenance procedures should also be followed for the BMPs which were implemented to keep eroded soil or concentrated runoff away from the mulched area. Follow maintenance procedures in the appropriate BMPs.

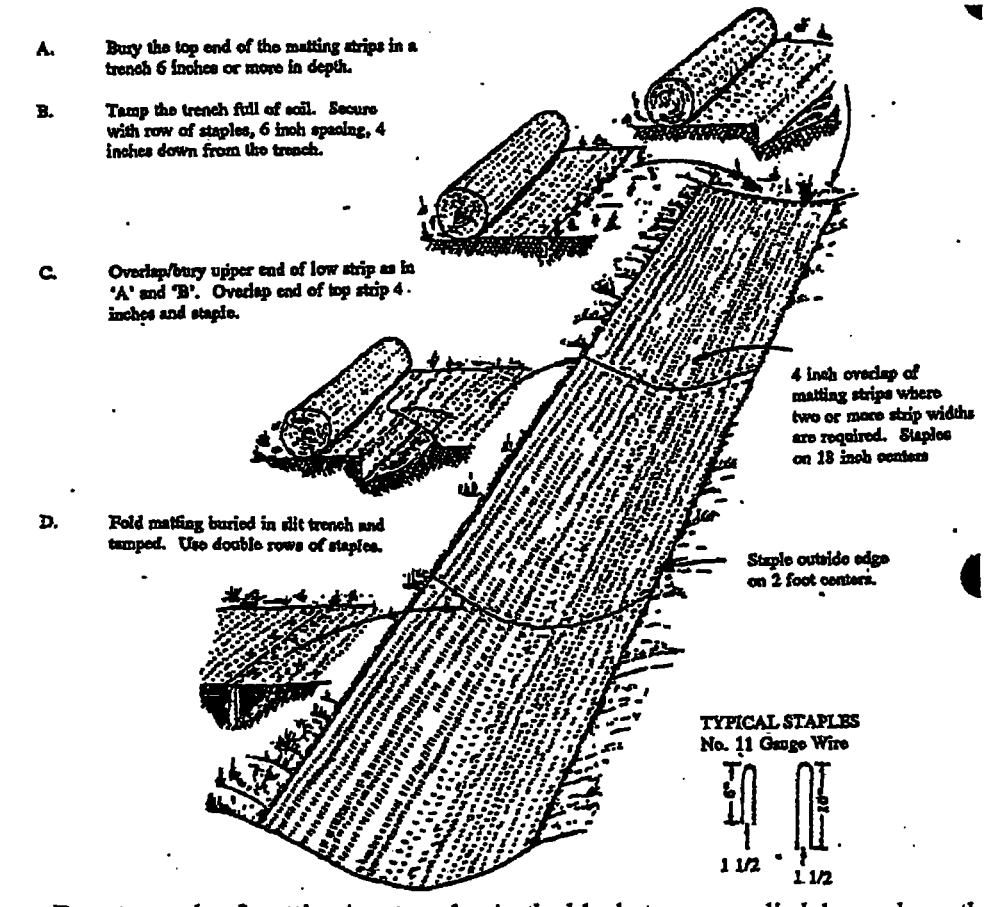
Exhibits

Exhibit 1: Installation of Netting and Matting for Erosion Control. Modified from the 1983 Maryland Standards and Specifications for Soil Erosion and Sediment Control.

Exhibit 1

Installation of Netting and Matting for Erosion Control

Below are general principles for installing netting and matting. Always follow the manufacturer's recommendations.



1. Bury top ends of matting in a trench. As the blankets are unrolled down slope, the matting must be on top with the wood fibers, seed, etc. in contact with soil. Butt snugly at the ends and side before stapling.

2. Staple, following manufacturer's recommendations.

3. Make sure matting is uniformly in contact with the soil.

4. Make sure all lap joints are secure.

5. Make sure all staples are flush with the ground.

Source: Modified from 1983 Maryland Standards and Specifications for Soil Erosion and Sediment Control.

Seeding

Description

Seeding is the establishment of a temporary or permanent vegetative cover by planting seed. For the purposes of this BMP, "grass" and "turf" will be used interchangeably.

This BMP does not address planting individual sprigs of grasses or other vegetation. See the Trees, Shrubs, and Ground Covers BMP for information on planting sprigs.

Other Terms Used to Describe

Hydroseeding
Vegetative Cover

Pollutants Controlled and Impacts

Once established, turf helps keep soil on site, absorbs nutrients, and allows groundwater recharge.

Application

Land Use
This BMP is applicable to all land uses.

Soil/Topography/Climate
Vegetative establishment is important on all exposed areas, but particularly on sloping terrain and areas adjacent to waterbodies or wetlands. It is also important in areas which frequently flood or which are impacted by spring runoff or strong winds.

When to Apply
Seed should be applied immediately after grading and preparation of the seed bed is finished on each small segment of a construction project. Mulch and/or soil erosion control blankets should be used to keep seed in place until the vegetation is established.

Where to Apply
Apply on all construction or earth change sites which require temporary or permanent vegetative stabilization.

Relationship With Other BMPs

Seeding can be used in conjunction with almost all temporary and permanent soil erosion and sedimentation control measures. Any fertilizer or lime that is applied should be done based on the results of soil tests. See the Soil Management BMP. Mulching should be used in conjunction with seeding to ensure establishment of an effective vegetative cover.

Proper grading is needed to ensure the seed bed is adequate for seed application. See the "Site Preparation" section, below.

Specifications

Planning Considerations:

1. The proper species of seed should be selected following basic integrated pest management practices (see the Pesticide Management BMP). To reduce the amount of fertilizer, pesticides and other inputs needed, choose adapted varieties based on environmental conditions, management level desired, and the intended use. Consider mixes because they are more adaptable than single species.

2. The proper time to seed is dependent upon the climate of the area. In Michigan, there are three different climatic areas which determine when seeding should occur. These are included in Exhibits 1 and 2.

   Seeding dates for permanent cover and dormant seeding are given in Exhibit 1. Dormant seeding is done after the normal growing season, using seed which will lay dormant in the winter but start growing as soon as soil conditions are favorable. Note that perennial grasses should be used for all permanent cover.

   To determine seeding dates for temporary cover use Exhibit 2. Note that the seeds listed here are annual grasses. Be sure to use annual grasses for all temporary cover. Seed mixtures for temporary seeding usually consist of rye or wheat. These species grow better after over-wintering (via a process called vernalization).

3. Seeding mixture for permanent cover. For permanent cover, the appropriate seeding mixture is determined in a two-step process. First, consult Exhibit 3, which lists various land uses and site conditions. Determine conditions at your site and use the table to come up with an appropriate seeding mixture number. Exhibits 4 and 5 indicate the various species and seeding rates associated with the selected seeding mixture number on a pound per acre and 1,000 square foot basis, respectively.

   Seeding mixtures for dormant seedings. Use Exhibits 3, 4, and 5 to determine proper seeding mixtures. Dormant seedings are completed in the late fall after the soil temperature remains consistently below 50°F. Perennial grasses are to be used with all dormant seedings.

   Seeding mixtures for temporary cover. Temporary vegetative cover is provided to protect Spoil Piles and larger areas which are staged. Seeding mixtures for temporary vegetative cover are given in Exhibit 2.

4. Subsurface Drains may be needed where water movement may cause seeps or soil slippage. Wet waterways should be tiled to ensure the vegetation is established.

5. Note: Some wildflower seed packages contain seeds of plant species which will compete with native plants. For example, some packages contain purple loosestrife, which is detrimental to cattail populations. The Department therefore does not recommend wildflower plantings unless the seed can be certified as being native to Michigan and is appropriate to the soil and other site conditions.

Site Preparation:

1. Consider protecting seeded areas from pedestrian access using the Construction Barriers BMP.

2. Where possible, divert concentrated flows away from the seeded area at least until the vegetation is established. Follow specifications in the Diversions BMP.

3. Soil tests should be done to determine the nutrient and pH content of the soil. Depending on the results of soil tests, Soil Management may be necessary to adjust the pH to between 6.5 and 7.0 (for most conditions). All lime, fertilizer and other soil amendments should be addressed following the Soil Management specifications. Note that sandy loam, loam, and silt loam are the preferred soils for seeding. Consideration should be given to incorporating these soils into the seedbed.

4. Prepare a 3-5-inch deep seedbed, with the top 3-4 inches consisting of topsoil. Note that the earth bed upon which the topsoil is to be placed should be at the required grade.

5. The seedbed should be firm but not compact. The top three inches of soil should be loose, moist and free of large clods and stones. For most applications, all stones larger than 2 inches in diameter, roots, litter and any foreign matter should be raked and removed. The topsoil surface should be in reasonably close conformity to the lines, grades and cross sections shown on the grading plans.

6. Slopes steeper than 3:1 should be roughened.

Planting:

1. Seed should be applied as soon after seedbed preparation as possible, when the soil is loose and moist. If the seedbed has been idle long enough for the soil to become compact, the topsoil should be harrowed with a disk, a spring tooth drag, a spike tooth drag, or other equipment designed to condition the soil for seeding. Harrowing should be done horizontally across the face of the slope.

2. Always apply seed before mulch.

3. Apply seed at the rates specified in the attached Exhibits using calibrated spreaders, cyclone seeders, mechanical drills, or hydroseeders.

4. Ideally, broadcast seed should be incorporated into the soil by raking or chain dragging, or otherwise floated, then lightly compacted to provide good seed-soil contact.

5. For hydroseeding operations:

   - Seed should be applied at recommended rates. If no rates are given, use 150-200 lbs/acre.

   - Use 2 tons/acre straw mulch, unless otherwise recommended. Use 3 tons/acre when dormant.

- If recycled newsprint is used, follow specifications in the Mulching BMP.

6. All newly seeded areas should be protected from erosive forces by mulch. See the Mulching BMP.

7. Species of grasses which cannot be planted with seed should be planted by sprigging or sodding. See the Trees, Shrubs and Ground Covers BMP for information on sprigging, and the Sodding BMP for information on sodding.

8. Excess topsoil should be disposed of following specifications in the Spoil Piles BMP.

Maintenance

Newly seeded areas need to be inspected frequently for the first few months to ensure the grass is growing. If the seeded area is damaged due to runoff, additional stormwater measures may be needed. Spot Seeding can be done on small areas to fill in bare spots where grass didn't grow properly.

Once the vegetation is well established:

1. Construction Barriers may be removed.

2. Water the grass following specifications in the Lawn Maintenance BMP.

3. If the grass is to be mowed, keep it to a height appropriate for the species selected and the intended use. Follow mowing specifications in the Lawn Maintenance BMP.

4. Occasional soil tests should be collected and analyzed to determine if the soil is appropriately fertilized. Follow the procedures in the Soil Management BMP.

5. Control pests following specifications in the Pesticide Management BMP.

6. Refer to the Lawn Maintenance BMP for determining the steps which can be taken to improve unhealthy turf.

Exhibits

Exhibit 1: Seeding Dates for Permanent Cover. Modified from the Soil Conservation Service Technical Guide, #342.

Exhibit 2: Seeding Dates for Temporary Vegetation. USDA Soil Conservation Service Technical Guide, #342.

Exhibit 3: Determining the Appropriate Seed Mixture. Extracted from USDA Soil Conservation Service Technical Guide, #342.

Exhibit 4: Seeding Mixture (in pounds/acre). Extracted from USDA Soil Conservation Service Technical Guide, #342.

Exhibit 5: Seeding Mixture (in pounds/1,000 ft^2). Extracted from USDA Soil Conservation Service Technical Guide, #342.

Exhibit 1

Seeding Dates for Permanent Cover

Zones	Normal Seeding Dates	Dormant* Seeding Dates
Lower Peninsula, South of U.S. 10	May 1 to October 10	Nov. 1 to freeze up
Lower Peninsula, North of U.S. 10	May 1 to October 1	Oct. 25 to freeze up
Upper Peninsula, entire area	May 1 to Sept. 20	Oct. 20 to freeze up

* Dormant seeding may be done in the late fall after the soil temperature remains consistently below 50°F. This is appropriate if construction on a site is completed in the fall but seed was not planted prior to Normal Seeding Dates. Since the initial temperature for seed germination is approximately 50 degrees F (soil temperature), this practice intends germination will not occur until spring. Extra cereal rye, a cool season annual grass, may be added to attempt to get some fall growth.

- Mulching must be used on any dormant seed. This is particularly important on erosive sites.
- Do not seed when the ground is frozen or snow covered.
- Do not use a dormant seeding on Grassed Waterways.

Source: Modified from USDA Soil Conservation Service Technical Guide.

Exhibit 2

Seeding Dates for Temporary Vegetation Cover

Planting Zones:

1. Lower Peninsula, South of US 10.
2. Lower Peninsula, North of US 10.
3. Upper Peninsula.

Zone			Kind of Seed	Amount	
1	2	3		Per 1,000 Sq. Feet	Per Acre
Apr. 1 to Sept. 15	Apr. 15 to Aug. 1	May 1 to Aug. 1	Oats*, barley*	2 lbs.	3 bu.
June-July	June-July	Not. rec.	Sudangrass	1 lb.	30-40 lbs.
Aug. 1 to Oct. 15	Aug. 1 to Oct. 10	Aug. 1 to Oct. 1	Rye*	3 lbs.	2-3 bu.
Sept. 20 to Oct. 15	Sept. 10 to Oct. 10	Sept. 1 to Oct. 1	Wheat	3 lbs.	2-3 bu.

* Indicates species best suited for wildlife food.

Immediately after seeding, mulch:
-all slopes
-unstable soils, and
-heavy clay soils
with unweathered small grain straw or hay spread uniformly at a rate of 1.5 to 2 tons per acre, or 100 pounds (2-3 bales) per 1,000 square feet. Other suitable materials may be used, according to specifications in the Mulching BMP.

Source: USDA Soil Conservation Service Technical Guide #342

Exhibit 3

Determining Appropriate Seeding Mixture Numbers Based on Site Conditions.

Site	Rough Areas	Steep Areas Ditch Banks Cuts Fills	Utility Rights-of way	Pond Edges[b]	Grassed Waterways Diversions[b]
Well and moderately well drained sand and loamy sand (coarse textured soils)	sunny-1, shady-2 or 4	4 or 6	15	4	4
Well and moderately well drained, moderately coarse to moderately fine textured soils (sand loam, loam, silt loam, and clay loam)	sunny-1, shady-2 or 5	4, 7, 8, 9, or 19	15	11 or 14	11, 13 17, 20
Well and moderately well drained clay and or 5 silty clay (fine texture soils)	sunny-1 shady-2	7, 8, 9, 13 or 19	15	11, 12 or 14	11, 13, 17, 20
Somewhat poorly drained or poorly drained soils without artificial drainage[a]	3 or 5	8, 10, 13 or 16	15	12 or 13	17, 18
Organic soils[a]	3	10, 16 or 18	16	11 or 12	

[a] With artificial drainage, use the appropriate site condition in the well-drained groups above.

[b] Mixtures one and two can be used on grassed waterways that are to be given care and management as lawn.

Source: USDA Soil Conservation Service Technical Guide #342

Exhibit 4

Seeding Mixtures (in pounds per acre) Corresponding with Seeding Mixture Number

Under the seed mixture number selected in Exhibit 3, use all species shown in that column. For example: for Exhibit 3, seeding no. 6, the correct seeding mixture is 25 lbs. of creeping red fescue plus 5 lbs. of perennial ryegrass and 20 lbs. of tall fescue. These are minimum rates for ideal conditions. Use judgement to increase rates for less than ideal conditions.

Seeds Per Pound	Species	Seed Mixtures From Exhibit 3*																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
615000	Creeping red fescue**	20	30	10	40		25		20						20	20					
227000	Perennial ryegrass	(a)	(a)		(a)		5					5	5			5		5	5		
2177000	Kentucky bluegrass	20	10	25					5						15						
4990000	Redtop**								1							1	1	2	2		
533000	Reed canarygrass**										10						10				
8700000	Seaside bentgrass											1	1	1	1						
136000	Smooth bromegrass**											30		15		10		25			20
227000	Tall fescue					50	20		20	10			40	15		15			30	15	21
1230000	Timothy**							3	2								4				
375000	Birdsroot trefoil (b)**							10	10											10	
110000	Crownvetch (b)**									15											
TOTAL POUNDS		40	40	35	40	50	50	13	58	25	10	36	46	31	36	51	15	32	37	25	40

Seed per square foot at the recommended seeding rate

(a) Five pounds of ryegrass may be added to this mixture on erodible sites or other areas where quick cover is essential

(b) Inoculate all legume seeds with correct inoculant.

* Seeding rates have been rounded off.

** Indicates species best suited for wildlife cover.

Source: USDA Soil Conservation Service Technical Guide #342

Exhibit 5

Appropriate Seeding Mixtures (in pounds/sq. ft.) Corresponding with Seeding Mixture Number

Under the seed mixture number selected in Exhibit 3, use all species shown in that column. For example, for Exhibit 3, seeding no. 6, the correct seeding mixture is .6 lbs. of creeping red fescue plus .2 lbs. of perennial ryegrass and .5 lbs. of tall fescue. These are minimum rates for ideal conditions. Use judgement to increase rates for less than ideal conditions.

Seeds Per Pound	Species	Seed Mixture From Exhibit 3*																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
515000	Creeping red fescue**	.5	.7	.3	1.0		.6		.5						.75	.75					
227000	Perennial ryegrass	(a)			(a)		.2					.2	.2			.2		.2	.2		
2177000	Kentucky bluegrass	.5	.3	.6					.2						.4						
4990000	Redtop**								.03						.03	.03	.05	.05			
533000	Reed canarygrass**										.3						.3				
8700000	Seaside bentgrass											.03	.03	.03	.03						
136000	Smooth bromegrass**											.7		.4		.3		.6			.5
227000	Tall fescue					1.2	.5		.5	.3			1	.4		.4			.7	.4	.5
1230000	Timothy**							.1	.05								.1				
375000	Birdsroot trefoil[b] **							.3	.3											.3	
110000	Crownvetch[b] **									.4											

[a] 0.15 pounds of cereal ryegrass may be added to this mixture on erodible sites or other areas where quick cover is essential.

[b] Inoculate all legume seeds with correct inoculant.

*Seeding rates have been rounded off.

**Indicates species best suited for wildlife cover.

Source: USDA Soil Conservation Service Technical Guide #342

Dec. 1, 1992

Soil Management

Description

Soil management is managing soil to provide the best growing conditions for turf and other vegetation. It may include adding lime, fertilizer, topsoil or other constituents to the existing soil to address low fertility, abnormal moisture content or inappropriate pH. It also includes cultivation and drainage techniques.

All soil additions (amendments) should be based on the results of soil tests. Soil samples should be taken following procedures in the attached Exhibit.

Other Terms Used to Describe

Liming
Soil conditioning
Soil preparation

Pollutants Controlled and Impacts

Proper soil treatment applied in conjunction with proper vegetative establishment will help prevent erosion and promote the filtering of runoff water. Soil treatment will also reduce the potential of groundwater contamination by providing a better environment for vegetative growth.

Application

Land Use
The BMP is applicable to all land uses where soils will be used for vegetative establishment.

Soil/Topography/Climate
Soil management varies based on soil classification and the use of that soil.

When to Apply
Certain aspects of this BMP will need to be applied at various times throughout the year. For example, when establishing new turf areas, liming materials should be incorporated into the soil before or during final seedbed or sodbed preparation.

Where to Apply
Apply to all soils.

Relationship With Other BMPs

This BMP is used in conjunction with all vegetative BMPs, as well as the Pesticide Management and Fertilizer Management BMPs.

Specifications

General Considerations:

Naturally existing soils are divided into layers called horizons (see Exhibit 1). These horizons may differ by pH, organic content, moisture, texture, etc. For the purposes of providing good soils for vegetation, only the top two soil layers are of concern. Exhibit 2 shows typical plants which can survive at various pHs.

Changes to the characteristics of the soil may be needed if the soil is not suitable for its intended use (e.g. if the soil is to support a building, its composition will be completely different than if its purpose is to grow grass). Therefore, first determine what the intended use of that soil is.

Since many land uses involve the establishment of grasses and other vegetation, the remaining text of this BMP is devoted to soil amendments for improving vegetative growing conditions. Refer to Exhibit 3, the USDA Soil Texture Classification, to determine soil texture based on the percentage of clay, silt or sand. This chart helps clarify what soils like "loam" and "clay loam" are comprised of.

All soil additions should be done based on the results of soil tests. Exhibit 4 is a step-by-step procedure for collecting soil samples. The Michigan State University, Cooperative Extension Service (MSU, CES) lab can analyze the samples, and staff can offer suggestions on the appropriate amount of fertilizer and other additives that are needed. Exhibit 5 lists the MSU CES laboratory fees.

The discussion below includes possible treatments which will be needed based on the results of the soil test. Much of the information was derived from "Turfgrass Pest Management," Michigan State University, Cooperative Extension Service, Bulletin E-2327.

pH:

pH is a measure of acidity. Soils with a pH less than 7 are considered acid, while soils with pH greater than 7 are considered alkaline. A pH of 7.0 is considered to be neutral.

Although most turf grasses grown in Michigan will grow well under a wide range of soil pH conditions, the optimum pH range for turf grasses is 5.0 to 7.5, depending on the turf species selected. Some acid-loving plants such as blueberries and rhododendrons prefer pHs between 4.0 and 7.0. Again, the type of plant to be grown in the soil will determine the pH requirements. Determine pH by soil test.

If the pH is too low:

Soils that are too acidic for the plant type should be treated with lime to raise the pH. This is particularly important because as the soil becomes more acidic, metals become more soluble. As metals become soluble they can be more easily transported to surface and ground waters. Lime should be mixed into the soil to a depth of at least 3 inches before seeding or sodding.

If the pH is too high:

pH levels higher than the optimum range (to 7.5) are generally not encountered in Michigan. Where necessary, sulfur or sulfur compounds may be added to lower the pH to the optimum range.

In droughty soils:
Droughty soils may be caused by a lack of irrigation, or because of a lack of organic material. Determine the cause of the droughty condition, then adjust the irrigation schedule, or add organic matter, loamy material, or preferably, topsoil to increase the moisture holding capacity of the soil.

Nutrients (Phosphorus and Nitrogen):
Nutrients in a soil are in constant flux, becoming more or less available as soil conditions change. Fertilizers sold commercially contain varying amount of the 16 mineral elements essential for turf growth and development, nitrogen, phosphorus and potassium being the three most common elements. Remember that only a soil sample will tell you how much of each nutrient is available in your soil.

Nitrogen:
Nitrogen is an essential element for plant growth. Because nitrogen makes grass "green," it is often used in excess of what the plant needs. Nitrogen which is not absorbed by vegetation can leach through the soil and into the groundwater. During this leaching process, nitrogen is converted into nitrate, which can contaminate drinking water supplies and cause health problems. The Environmental Protection Agency limits the acceptable level of nitrate in drinking water to 10 ppm (parts per million).

Nitrogen is often unavailable to turf roots because it leaches through the soil rapidly. Turf deficient in nitrogen may have poor color, decreased elasticity, and is less able to compete with weeds. Apply nitrogen based on soil tests. Do not apply any more than one pound of actual nitrogen per 1,000 square feet during a single application.

Phosphorus:
Phosphorus is important for root development, maturation, and seed production. This element is found chemically bound to oxygen; two particles of phosphorus are bonded to five oxygen particles (P_2O_5). Since this molecule is practically immobile in soil, few soils are deficient in phosphorus. Soils that are deficient show purpling of grass blades. Note that this symptom can be confused with the color change induced by cold weather.

Many Michigan soils have been historically over-applied with phosphorus. Since phosphorus binds readily with soil, excessive applications of phosphorus which are carried off in eroded soil can result in algae blooms and nuisance aquatic plant growth. This, in turn, results in eutrophication.

Phosphorus fertilizer must be delivered directly to turf roots. This can be done by fertilizing after aeration or by liquid fertilizer injection. Apply all phosphorus amendments based on the results of soil tests.

Potassium:
Turf uses potassium in quantities second only to nitrogen. This element is important for rooting, and wear and climatic stress tolerance. While rarely visually evident, turf deficient in potassium has yellowing and dead blade tips.

Potassium generally does not cause water quality problems, nor is it over-applied in the same manner as phosphorus and nitrogen. Apply potassium amendments on the basis of soil test results.

For all Nutrient-Deficiencies:
If soils are nutrient-deficient, follow specifications in the Fertilizer Management BMP.

Micro-Nutrients:
Micronutrients are elements used by plants in relatively small amounts. They include manganese, boron, copper, and zinc. Typically, micronutrients required by turf are naturally present in Michigan soils in adequate amounts. High soil pH, however, can render these elements insoluble, making them unavailable to turf roots. Iron is an example of a micronutrient that is commonly deficient in alkaline soils (i.e. those soils with a pH greater than 7). Iron is required for chlorophyll production, and therefore the green coloring of plants. It is also important for root and shoot development and drought resistance. Iron-deficient turf usually has blotchy yellow patches. Severe iron deficiencies may result in white grass blades or the death of plants. Application of iron fertilizer will provide temporary green-up of turf. Since the deficiency is due to soil alkalinity, long-term treatment requires modifying the soil pH.

Soil Organisms:
Living and decaying soil organisms contribute greatly to a soil's organic matter and fertility. As they burrow, organisms break down organic matter, making nutrients available for absorption by turf roots.

Earthworms are the best known of soil organisms, but a great number of microorganisms also occupy the soil. One teaspoon of soil can contain a billion bacteria, a million fungi, and several thousand algae. Most of these organisms improve soil conditions for plants.

Turf managers who appreciate the benefits of soil life are careful not to destroy it with unnecessary soil amendments. Again, make amendments to the soil based on the result of soil tests.

Managing for Compacted Soils:
Compacted and heavy clay soils contain less air and have a hard surface that drains poorly. Turf growing in such soils lack air and beneficial micro-organisms, and suffer from poor drainage. Root development and turf quality declines.

Mechanical aerators create holes in compacted and heavy soils. This practice increases the movement of air in the soil and improves drainage. Machines that remove cores from the soil are generally more efficient aerators than those that spike or slit the soil. Coring machines remove a quarter to one-inch diameter cores and deposit them on the surface of the turf. Fall is the best time to aerate turf, when weed seed germination is at a minimum.

When practical, break up deposited cores by dragging chain-linked fence or similar material over them. Cores of poor quality soil should be discarded. Holes will more rapidly be covered by turf if the area is top dressed, seeded and fertilizer is applied directly after aeration. Follow this with a light watering. Fall is the best time to aerate turf, when weed seed germination is at a minimum.

Site Preparation:
For established areas:

1. Collect soil samples following the procedures in the attached Exhibit.

2. Discuss the soil test results with the local Soil Conservation District or Cooperative

Extension Service staff, and buy the recommended amount of fertilizers, lime, or other needed amendments. Apply fertilizers following specifications in the Fertilizer Management BMP. Lime should not be spread using a hydroseeder. It can be blown onto steep slopes in dry form. For the application of compost, see the Organic Debris Disposal BMP.

For a typical seeding or sodding operation as part of a construction project:

1. Collect soil samples following the procedures in the attached Exhibit.

2. Discuss the soil test results with the local Soil Conservation District or Cooperative Extension Service staff and buy the recommended amount of fertilizers, lime, or other needed amendments.

3. In large areas, topsoil should be removed and stored in storage piles according to specifications in the Spoil Piles BMP.

4. Where appropriate, grade following specifications in the Grading Practices BMP. Complete all cut and fill activities. Use Diversions and other BMPs to prevent soil erosion and sedimentation. Follow the site plan.

5. The earth bed upon which the topsoil is placed for seedbed and sodbed preparation should be at the required grade.

6. Work lime, fertilizer and other additives into the topsoil, either before or during final seedbed preparation, or before sod is laid. Lime should be mixed into the soil to a depth of at least 3 inches before seeding or sodding. Lime should not be spread using a hydroseeder. It can be blown onto steep slopes in dry form. For all seeding applications, follow specifications in the Seeding BMP.

   For all sodding applications, follow specifications in the Sodding BMP. For the application of compost, see the Organic Debris Disposal BMP.

7. Inoculate all legume seed in accordance with the manufacturer's recommendations.

Maintenance

If the vegetation doesn't grow according to its intended use, additional soil tests may need to be taken and analyzed for other parameters. Additional soil samples should also be taken as new areas are developed.

Once vegetation is established, additional soil amendments, including fertilizers, should only be made based on the results of soil tests.

Additional Considerations

Treating soils on-site is less expensive than importing soils from off-site. Existing soils are also usually compatible with the lower horizons.

Exhibits

Exhibit 1: Soil Horizons. Michigan Department of Natural Resources, Soil Erosion Control Unit.

Exhibit 2: pH Toxicity Chart. Michigan Department of Natural Resources, Soil Erosion Control Unit.

Exhibit 3: USDA Soil Texture Classification.

Exhibit 4: How to Collect a Soil Sample. Compiled from several sources.

Exhibit 5: Michigan State University Testing Laboratory Fee Schedule. Lists prices effective July 1, 1990.

Exhibit 1:

Soil Horizons

Horizon O - This uppermost horizon consists of detritus, leaf litter, and other organic material lying on the surface of the soil. This layer is dark because of the decomposition that is occurring, and is usually 0" to 2" deep, or it may be as deep as 16" for poorly drained, unclassified soil.

Horizon A - The second layer of soil, called topsoil, is darker than the lower layers. It is loose and crumbly with varying amounts of organic matter. In cultivated fields, the plowed layer is topsoil. As water moves down through the topsoil, many soluble minerals and nutrients dissolve. The dissolved materials leach from the topsoil. This is generally the most productive layer of soil, and ranges from 2" to 10" in depth.

Horizon B - The third layer is commonly called subsoil. This layer is usually light colored, dense, and low in organic matter. The subsoil is a zone of accumulation since most of the materials leached from the topsoil accumulate here. This zone ranges from 10" to 30" in depth.

Horizon C - This layer is beneath the subsoil. It is lighter in color than the subsoil. It is typically described to a depth of 60" in soil survey reports, but may be many feet thick. It may or may not be like the material from which the A and B horizons have formed. If it is dissimilar, it is designated as 2C or IIC.

Horizon R - This layer represents bedrock.

Source: Michigan Department of Natural Resources, Soil Erosion Control Unit.

Exhibit 2

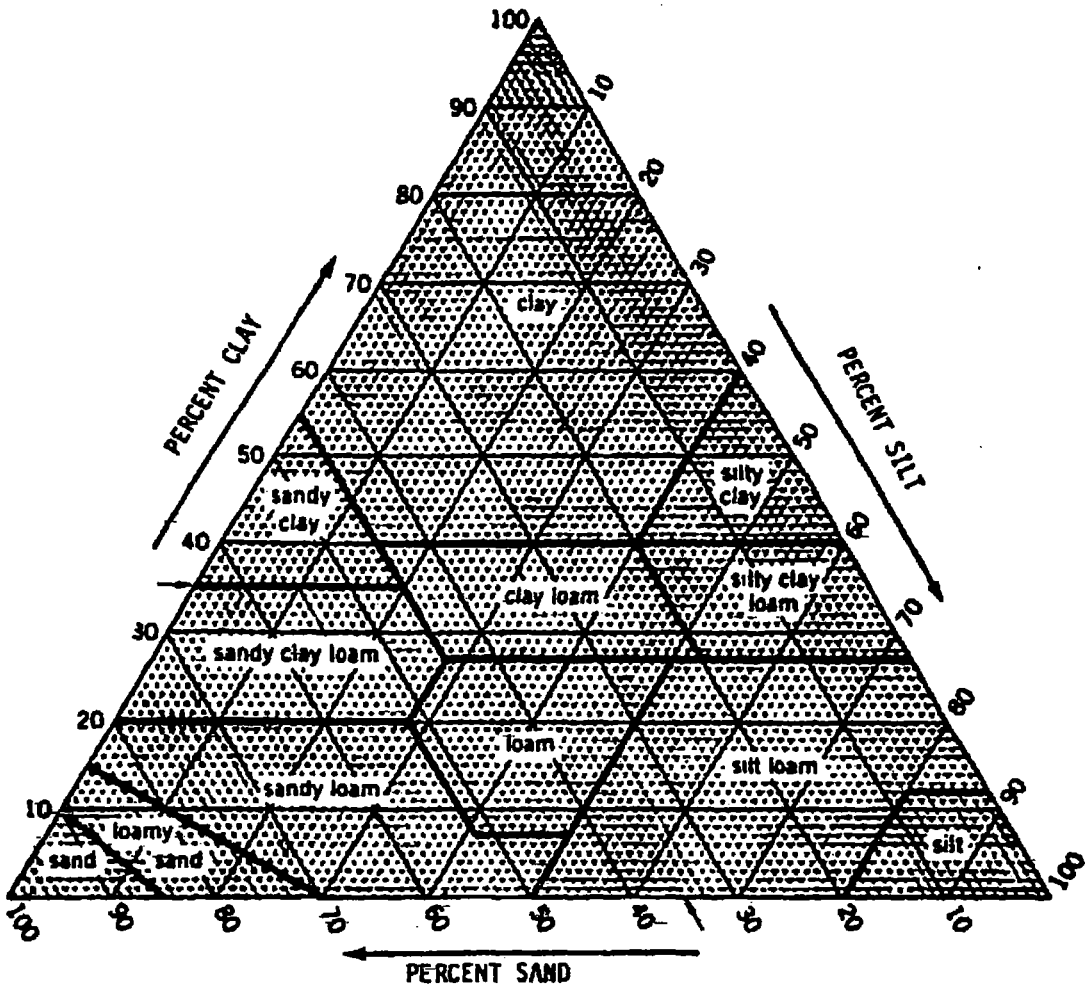
pH Toxicity Chart

	pH		
	14		
B	13		
A	12	Typical Basic Soils	Typical Plants Tolerant of Basic Soils
S	11	Alpena, Aurelius, Barry, Belleville	Willow, American Elm, Poison Sumac, Poison Ivy
I	10		
C	9		
	8		
	7	Neutral	Vegetation grows best when it is within the range of 5.5 and 8.0
	6		
	5		
A	4		
C	3	Typical Acid Soils	Typical Plants Tolerant of Acid Soils
I	2	Burt, Champion, Gogebic, Isabella	Red Maple, Balsam Fir, Bunchberry
D	1		
	0		

Source: Michigan Department of Natural Resources, Soil Erosion Control Unit.

Exhibit 3

USDA Soil Texture Classification



Source: USDA, Soil Conservation Service

Exhibit 4:

How To Collect a Soil Sample

Soil tests are generally collected and analyzed for nitrate-nitrogen, phosphorus, and pH. As discussed in the Lawn Maintenance BMP and above, BMP, nitrogen and phosphorus are two of the three primary nutrients which make up commercial fertilizers. Fertilizers put on the soil in excess of that which is needed by the plant may 1) run off the soil into lake, rivers and streams, causing algae blooms; or 2) leach through the soil and impair groundwater supplies.

Generally, a representative sample should be taken. This may mean only a few samples, as in the case of an average one-acre yard, or a dozen or more, as in the case of a large field. The more variety of soil textures in the area to be vegetated, the more samples that should be taken. Turf areas that differ significantly in grass type, use, or growing conditions should be analyzed separately.

Remember that there are three primary types of soil textures are sands, silts and clays. Soil which is comprised of a mixture of sand, silt and clay is called loam. Use Exhibit 3, the USDA Soil Texture Classifications, to determine the soil textures of your soils.

Step by step process:

For Yards/Lawns Less than 1 Acre:

1. Take a spade or trowel and stick it in the soil to a depth of 4-5 inches at a 45-degree angle (to make a V-shaped cut). Take the spade out and move it 1/2-inches away from the first cut and dig out a 1/2-inch chunk of soil. Then, trim off from each side of the spade all but a thin ribbon of soil down the center of the spade face. Place this in a clean bucket, plastic container or paper bag. Do not contaminate samples by mixing them in a metal container.

2. Take additional samples, as needed for different textures of soils, and for the different ways turf can differ--by grass type, use, or growing conditions. Add the soil to the bucket/container and mix thoroughly.

3. Air dry the sample by spreading the soil out in the bottom of the bucket/container, or, if a lot of soil is collected, in the bottom of a flat pan.

4. When the soil is dry, mix it thoroughly. Then take out about a half-pint, and put it in a jar for testing.

5. Take the soil test to the county Cooperative Extension Service (CES) office or a private lab experienced in the analysis of soils. Be prepared to answer questions about the amount of fertilizer you've used in the past, the spreading/spraying technique used, and the type of grass or sod the fertilizer will be applied to. Also indicate to the CES staff any problems which have been encountered on the lawn: look for thin spots, brown spots, etc.

Exhibit 4 (Con't)

6. The CES staff will have the soil test analyzed and present you with the results, along with a recommendation for the amount of fertilizer needed, the application rate, the best time to apply the fertilizer, and frequency of applications. By tailoring fertilizer applications to your lawn, you will put on only what is needed, thus saving money and protecting surface and ground waters, and will likely save money.

7. Homeowners should have their soil tested once every three or four years, unless additional problems arise.

For Yards Larger than 1 Acre, Including Parks, Cemeteries, etc.

1. Get a copy of a soils map from the Soil Conservation District or the Cooperative Extension Service to identify the number and types of soils on your property.

2. Collect soil tests to a depth of 4-5 inches and 1/2-inch thick using a spade, soil auger or soil sampling tube.

3. Trim off from each side of the spade all but a thin ribbon of soil down the center of the spade face. Place this in a clean bucket.

4. Take additional samples, as needed for each different type of soil identified on the soil map. If you were unable to access the soil map, at least take additional samples for each soil texture (sand, silt, or clay). Add the additional soil samples to the bucket.

5. Follow steps 3 - 6 in the above section.

6. People with large acres to manage should collect soil samples annually.

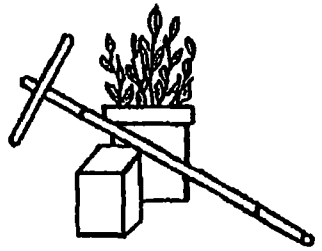
Compiled from several sources.

MICHIGAN STATE UNIVERSITY
SOIL TESTING LABORATORY

FEE SCHEDULE

For
SOIL ANALYSIS
And OTHER MATERIALS

(EFFECTIVE JULY 1, 1990)



Cooperative Extension Service
Crop and Soil Sciences Department
A81 Plant and Soil Sciences Building
East Lansing MI 48824-1325

Telephone (517) 355-0218
FAX (517) 355-1732

Exhibit 5

PRICES EFFECTIVE July 1, 1990

1a. REGULAR FIELD SOIL TEST. . . . . $ 6.00*
pH, lime requirement, P, K, Ca, Mg & recommendations

1b. REGULAR FIELD TEST PLUS ZN & MN $10.00*

*Samples coming into the lab not in pre-paid boxes add $.50 per sample for boxing

2. MICRONUTRIENT TESTS (Zn, Mn, Cu, & Fe) .$ 3.00/EA
(price is per micronutrient per sample)

3. GREENHOUSE TEST $14.00
(For artificial growth media) pH, Nitrate-N, P, K, Ca, Mg, soluble salts, Na, Cl and nutrient balance

4. SUPPLEMENTAL SOIL TESTS

a. Nitrate - Nitrogen . . . . . $ 3.00
b. Nitrate - N + Ammonium - N . . . . . $ 4.00
c. Sodium . . . . . $ 3.00
d. Chloride . . . . . $ 3.00
e. Soluble Salts . . . . . .$ 3.00
f. Organic Matter . . . . . $ 3.00
g. pH . . . . . $ 2.00
h. Total Nitrogen $12.00
i. C.E.C. by ammonium saturation . . . $15.00
j. Boron (analysis by U. Of Wisconsin). $ 5.50
Sulfur . . . . . $ 5.50

5. PARTICLE SIZE ANALYSIS $10.00
(percent sand, silt and clay)

6. GOLF COURSE ANALYSIS Sand Classification $15.00
(USGA size limits by wet sieving)

7. PEAT FOR SALE . . . . . .$ 7.00
(pH, organic matter, moisture content, peat type)

PRE-PAYMENT IS ENCOURAGED - OTHERWISE A SERVICE FEE OF $6.00 WILL BE ADDED

Exhibit 5 (con't.)

8. LIMESTONE ANALYSIS

a. Neutralizing Value, Sieve Analysis.....$18.00
% $MgCO_3$ and Moisture

b. Neutralizing Value only.....$ 6.00

c. Sieve Analysis only.....$ 6.00

d. Percent $MgCO_3$ only.....$ 6.00

9. MARL ANALYSIS

a. Neutralizing Value, $CaCO_3$ equivalent per cubic yard, % $MgCO_3$, % moisture.....$18.00

b. Neutralizing Value, $CaCO_3$ equivalent per cubic yard and % moisture.....$12.00

c. Percent $MgCO_3$ only.....$ 6.00

10. WATER TESTS

a. COMPLETE.....$12.00
(soluble salts, alkalinity, pH, Nitrate-N, P, K, Ca, Mg, Na and chloride)
b. Total Soluble Salts.....$ 2.00
c. Alkalinity.....$ 2.00
d. Nitrate-N.....$ 2.00
e. Nitrate-N + Ammonium-N.....$ 3.00
f. Any single soluble element.....$ 2.00

11. PLANT TISSUE ANALYSIS

COMPLETE tissue analysis includes N, P, K, Ca, Mg, Zn, Mn, Cu, Fe, B, Al and Mo.
a. Field Crop & Vegetable tissue.....$16.00
(includes interpretation of results)
b. Fruit trees, grapes, strawberries,.....$18.00
blueberries & raspberries (includes interpretation of results & computerized fertilizer recommendations)
c. Complete analysis without N.....$12.00
d. N alone.....$ 8.00

12. SUPPLIES

a. Soiltex pH kits.....$ 3.00

b. Hoffer Soil Sampling Probes.....$20.00

13. DISCOUNT INFORMATION
(on purchases of soil sample boxes only)

a. 0-99.....No discount
100-199.....4%
200-399.....8%
400 +.....10%

TURNAROUND TIME for Regular Soil Tests is one week, turnaround time for Greenhouse tests is two (2) days from receipt. A 20% surcharge will be added for Rush samples.

MSU SOIL TESTING LABORATORY
A81 Plant & Soil Sciences Building
Michigan State University
East Lansing, MI 48824
Phone: (517) 355-0218
FAX: (517) 355-1732

Dec. 1, 1992

Trees, Shrubs and Ground Covers

Description

This BMP addresses the selection and maintenance of woody plant materials, including trees, shrubs, and ground covers. Seed selection is discussed in the Seeding BMP, and sod selection in the Sodding BMP.

Trees, shrubs and ground covers can be used on steep or rocky slopes where mowing is not feasible. Once trees, shrubs and ground covers are well established they:

-help stabilize the soil, reducing both wind and water erosion
-reduce stormwater runoff by intercepting rainfall and promoting infiltration
-filter pollutants from the air and produce oxygen
-moderate temperature changes and provide shade
-provide some privacy
-improve aesthetic values and increase property values

In addition, ground covers can provide stabilization in areas which are heavily shaded.

Other Terms Used to Describe

Landscape Planting
Landscaping

Pollutants Controlled and Impacts

Tree, shrub and ground cover plantings: protect the soil from wind and water erosion, thereby reducing sedimentation in surface waters; utilize nutrients, thereby minimizing nutrient loading to surface water and nitrate leaching to groundwater; and filter soil that has eroded.

Application

Land Use
The BMP is applicable to all land uses.

Soil/Topography/Climate
Soils, topography and climate will all be considerations in selecting the appropriate trees, shrubs and ground covers for the site.

When to Apply
Plantings are usually done in the spring or fall, based on the following dates and depending on the type of vegetation.

Spring: April 15 - May 30
Fall: September 1 - October 30

Winter and summer plantings are generally not as successful.

Where to Apply
Apply at all sites where landscape planting will minimize soil erosion and/or enhance aesthetic values.

Relationships With Other BMPs

This BMP should also be used when trees, shrubs or ground covers are accidently damaged during Land Clearing operations. Trees, shrubs and ground covers are often incorporated into sites which need Critical Area Stabilization.

Specifications

Planning Considerations:
Wherever possible, **preserve existing woody vegetation.** Existing vegetation is more aesthetically pleasing, costs less than purchasing new species, and provides immediate shade, canopy and habitat. The identification of trees which should be preserved is discussed in the Tree Protection BMP.

For New Plantings:
1. Selection of appropriate species should be based on the following:

   Soil texture. Some species will grow best in certain soil textures. Information on soils for many counties is available from the local Soil Conservation District office. The Appendices include an update of the soils information that has been entered in the Department's land resources database.

   Soil tests may be needed to determine if nutrients or fertilizers need to be added to the site. All additions to the soil should be based on the results of soil tests. Follow the specifications in the Soil Management BMP.

   Exhibit 1 can be used as a starting point for selecting trees and shrubs based on soil conditions.

   Exhibit 2 can be used as a starting point for selecting ground covers based on soil conditions.

   Drainage classification. Drainage classification is reflective of the soil moisture condition of the soil. For example, species such as white birch will grow best if soil moisture is high. Other species such as Jack pines will "drown" and die in soils of high water content. Be sure to take the drainage classification of soils into consideration when selecting tress and shrubs.

   Native species. The type of vegetation which exists in the area is a good indicator of plants which will likely have good survival rates. These indicator species provide information on soil texture, drainage class, and fertility. Native vegetation or plant materials with similar

requirements can then be used.

Purpose (Use). The purpose for which the plant is being used should also be considered. If the plant is being added for shade, trees with fuller canopies should be selected. If the plant is being added to control soil erosion, then its rate of growth, type of root system, ground covering characteristics, and spacing between plants are important factors.

2. Because of the spacing required between many shrubs and trees, and because it takes time for most woody species to "take hold," soil erosion between plants may occur. To prevent erosion, mulch all sites which will be planted with woody species. See the Mulching BMP.

3. On steep slopes, stagger plantings and consider using erosion control mats or netting prior to placing to keep soil from eroding. Mats and netting should be slit to accommodate the shrubs. See the Filters BMP for information on the proper selection of nets and mats.

4. For areas in which trees or shrubs will be planted, any seeding that is done to help stabilize the area should consist of the least competitive plant species. Species such as tall fescue, which produces vigorous early growth, is highly competitive with tree seedlings and therefore should not be used. Species such as annual lespedezas, which starts growing relatively late in the spring, is much less competitive.

5. Any pruning that needs to be done should be completed before planting occurs and should be done by persons experienced in pruning.

   For deciduous trees: Prune to balance the loss of roots so as to retain the natural form of the plant type. The height ratio of the crown to the trunk after pruning should be approximately one-third crown to two-thirds trunk. The primary leader should not normally be cut back. Branches to be removed should be cut off flush with the trunk or main branch.

   For deciduous shrubs: Prune by removing all dead wood and broken branches, thinning out entire canes where they are too thick, cutting back or removing unsymmetrical branches and sufficient other growth to ensure healthy and symmetrical growth of new wood. Shrubs should be pruned so that they form a loose outline conforming to the general shape of the shrub type.

   Evergreen trees and shrubs: Evergreens should be pruned only to remove broken or damaged limbs.

6. In windy areas or where plantings will be done in stages, always begin planting on the windward side and progress across the area as it is being stabilized. Stagger trees in rows.

Trees:

Selecting Individual Trees:
Large nursery trees usually come with the roots and attached soil wrapped in burlap. As a rule of thumb, the soil ball of containerized and burlapped trees should be 12 inches in diameter for each inch of trunk diameter. Keep the soil around the roots moist until the tree is planted. Bind branches with soft rope to

prevent damage during transport.

Smaller nursery trees are usually sold in plastic containers as balled and burlapped stock, or as bare-root stock (seedlings):

Container-grown plants should have grown in the container for at least one growing season. If plants have been in the container too long they will show "pot-bound" root ends.

Balled and burlapped plants should be planted prior to "bud break." If planted in the fall, balling operations should not begin until after the plants have begun to "harden off." All plants should be dug and transported so that the ball is moist, and protected from rain or sudden changes in the weather.

Bare-root plants should only be handled in early spring, late fall or late winter. These plants should meet the following criteria to prevent a high rate of mortality:

Seedlings should be fresh smelling. Sour odor indicates that the seedlings have been stored too long and have begun to rot. Trees stored at correct temperatures will be free of mold.

The roots must be moist and glistening white when stripped of bark. Using a knife or fingernail, strip the bark off the root, working from base to tip. If the roots appear yellow, brown or have brown spots, the stock is badly damaged and has little chance of survival. Check the roots of several seedlings.

Buds must be firm, with no evidence of new growth.

Seedlings should be packed and shipped in wet moss or other medium, and kept cool (less than 34 degrees F) and moist prior to and throughout the planting process. Moss-packed seedlings should be kept in their container and kept moist. Clay-packed seedlings should not be watered, but should be covered with burlap if they are not to be planted soon after they are purchased.

Store packages of seedlings in a shaded location out of the wind.

Seedlings should be planted as soon as possible after they are received. If planting is delayed longer than four days after seedlings are received, "heel" the seedlings in a shaded area and keep moist. To heel in seedlings, dig a trench in soil that is shaded or in a well-ventilated enclosure. Place seedlings in the trench and cover the roots with soil. Replant when planting conditions allow.

Site Preparation:
Dig a hole at least deep enough and wide enough to hold the entire root ball. The final level of the root ball's top should be level with the ground surface. Keep topsoil separate from the subsoil. If the soils are clay, dig a deeper hole and backfill with some of the topsoil.

Planting:
Although the planting seasons for deciduous plants is between March 1 and October 1 or until the prepared soil becomes frozen, spring and fall are the best times to plant. Planting of evergreens should occur between March 1 and June 1, before new growth occurs.

Trees in containers and burlap will need to be planted individually. See Exhibit 3 and follow the steps below:

Trees in containers should be removed carefully so that all roots and soil remain attached. It may be easiest to cut the container. On balled and burlapped trees, loosen the twine and burlap at the top and check to make sure no other wrapping is present before planting.

Depending on the type of subsoil, it may be beneficial to mix a little peat moss into the soil.

The dug hole should be such that the plant is planted at the same depth as the original container.

Add water to settle the soil and eliminate air pockets. Once the water is drained off, lower the tree into the hole, backfill half way, and pat firm. Water again. Once the water is drained again, remove the burlap from ball and burlapped trees from around the trunk and the upper half of the ball. Fill the hole so that it is filled even with the ground line.

Backfill the hole and pat the soil firm. Leave a small depression around the tree so that water can run into the depression.

Add mulch around the tree to reduce competition from unwanted vegetation and to help prevent roots from drying out.

Bare-root seedlings should not be pruned prior to planting, except for broken or damaged roots. Plants can be planted either by hand or by machine. On large sites where slopes do not prohibit machinery, bare-root seedlings can be planted in furrows using a tree-planting machine.

A method of hand planting bare-root seedlings is shown in Exhibit 4. Plants should be set at a depth equal to the depth in their original location. The exposed roots should be held firmly in the proper position, with the roots spread out. The prepared soil should be watered around the roots and thoroughly firmed at intervals during the process of backfilling. Sufficient water should be used to ensure the soil is thoroughly saturated.

Spacing and Rates of Planting:
The proper spacing and rates of planting various tree species are shown in Exhibit 5.

Tree seedlings should *not* be fertilized during the first 12 months following planting because fertilizer tends to dehydrate newly planted trees.

Mulch between plants to prevent soil from eroding. Follow specifications in the Mulching BMP.

Plants Located on Slopes:
For plants located on slopes, a berm of prepared soil should be constructed halfway around each plant on the down-slope side. The berm of prepared soil should have an inside diameter equal to that of the planting hole, and a maximum height of 6 inches. Soil should not spill down-slope more than 18 inches.

Wrapping trees:
Trees should be wrapped within one week following planting. Trunks should be carefully wrapped beginning at the base of the trunk just above the roots and below the normal ground line, and should extend upward in a spiral with an overlap of one-half the width of the strip. The portion of the wrapping below the finished grade should be covered with soil. The paper should be held securely in place with masking tape.

Staking trees:
Newly planted trees often need to be staked for support. Trees which need to be staked should be secured with stakes and guy wires. Cushion the tree against the wire by placing old garden hose or equivalent between the tree and wire. See Exhibit 3.

Shrubs:

Selecting Shrubs:
For erosion control purposes, and when more than one species can be used, make the final species selection using the following characteristics:

-fast growing
-easy to establish
-have large lateral spread or prostrate growth (i.e. will grow outwardly to provide more cover)
-disease and insect resistant
-ability of the roots to fix nitrogen
-adaptation to a broad range of soil conditions

Like small trees, nursery shrubs usually come in plastic containers or as bare-root stock.

Site Preparation and Planting:
Follow the tree planting procedures for "Trees in containers and burlap," above. See Exhibit 3. Space shrubs approximately three feet apart.

It is important to mulch the entire area to keep other plants from competing with the desired plant and to cover exposed soil. See the Mulching BMP for mulching specifications.

Ground Covers:

Selecting Ground Covers:
When ground covers are to be used to help stabilize soils, select fast-growing, evergreens that require little maintenance.

Site Preparation:
The dense growth of ground covers requires that they have good soil. Well-drained soils high in organic matter work best. Make soil additions based on the results of soil tests. See the Soil Management BMP.

On steep slopes, till the soil in contour rows, or dig individual holes for each plant. Blend soil additions into the soil.

Planting:
Most ground covers are planted from container-grown nursery stock. Transplanting to the seedbed can be done using a small trowel or spade. Dig a hole large enough to accommodate the roots and soil. Backfill and firm the soil around the plant. Water immediately.

Space between plants based on how quickly full cover is achieved, usually between 1 and 3 feet apart.

Like with trees and shrubs, ground covers will be better protected from competitive species if the area is mulched. See the Mulching BMP for mulching specifications.

Maintenance

For New Plantings:

1. Check survival the first and second year and replant where survival is poor.

2. Where needed, control competing vegetation the first 2 or 3 years, preferably by mulching or cultivating.

3. Exclude livestock from all plantings.

For All Trees, Shrubs and Ground Covers:

Trees:
Seedlings are subject to competition with invading grasses and other vegetation. For hardwoods, vegetation must be controlled for at least three growing seasons. For conifers, vegetation must be controlled for at least two growing seasons. Mulch to prevent competition, or mow or clip competitive vegetation, where possible. Use herbicides only where mulching has failed and mowing and clipping are not possible. Follow guidelines in the Pesticide Management BMP.

Where soil tests indicate fertilizers are needed, fertilize in late fall or early spring before leaves emerge. For evergreens, use only 1/2 the recommended amount of fertilizer. Use a punchbar, crowbar or auger. Make holes about 18 inches deep and about 2 feet apart around the drip line of each tree. Distribute fertilizer evenly among the holes to bring it in contact with trees roots. Store and mix fertilizers following specifications in the Fertilizer Management BMP.

Ideally, newly planted trees should receive an inch of water each week for the first two years after planting. When rain does not supply this need, and where possible, the tree should be watered deeply but not more often than once per week.

Trees should be protected and unhealthy limbs cut following procedures in the Tree Protection BMP. Train and prune black walnut and other hardwoods to produce straight, single stemmed trees.

Christmas tree shearing should begin after the third year. Refer to the Soil Conservation Service Technical Guide, #660, Woodland Pruning.

Shrubs:
Maintenance of shrubs, including watering and fertilizing, depends upon the species. Maintain mulch around the base of each plant to reduce weed competition and retain moisture. See the Mulching BMP. Fertilizers are usually needed only once every 3 years or so, depending on the results of soil tests.

Pruning should be done as needed to remove dead limbs.

Ground Covers:
Most ground covers need yearly trimming to promote growth. Trim back from trees, flower beds, fences, and buildings. Add additional mulch as needed until the area is completely stabilized. Like shrubs, fertilizers may only be needed once every 3-4 years, depending on the results of soil tests.

Organic Debris Disposal:
Any organic debris which results from pruning, trimming or any other vegetative maintenance should be disposed of following specifications in the Organic Debris Disposal BMP.

Exhibits

Exhibit 1: Selecting Trees and Shrubs. USDA Soil Conservation Service Technical Guide, #342.

Exhibit 2: Selecting Ground Covers. USDA Soil Conservation Service Technical Guide, #342.

Exhibit 3: Planting Balled-and-Burlapped and Container-Grown Shrubs and Trees. North Carolina "Soil Erosion and Sediment Control Planning and Design Manual," as modified from the Virginia Division of Forestry.

Exhibit 4: A Method for Planting Bare-Root Seedlings and Sprigs of Grasses. Modified from the North Carolina "Erosion and Sediment Control Planning and Design Manual."

Exhibit 5: The Proper Spacing and Rates of Planting. USDA Soil Conservation Service Technical Guide, #612.

Exhibit 1
Selecting Trees and Shrubs

Soil Condition	Trees[1]	Shrubs[2]
1. Well and moderately well drained sand and loamy sand (coarse textured soils)	Austrian pine Jack pine* Red pine White pine* Black locust Cottonwood	Autumn olive Hawthorn Crabapple Tatarian honeysuckle Staghorn sumac Serviceberry
2. Well and moderately well drained, moderately coarse to moderately fine textured soils (sandy loam, loam, silt loam and clay loam)	Red pine White pine* Cottonwood Norway spruce* Jack pine* White spruce* Black locust Sugar maple*	Gray dogwood Autumn olive Crabapple
3. Well and moderately well drained clay and silty clay (fine textured soils)	White pine* Norway spruce* Black locust White spruce* Sugar maple* Red pine Cottonwood	Silky dogwood Tatarian honeysuckle Autumn olive Crabapple
4. Excessively wet (poorly drained) organic soils	Northern white cedar* White spruce* Red maple Silver maple Green ash Swamp white oak* Pin oak**	American cranberry bush Redosier dogwood Gray dogwood "Indigo" silky dogwood Nannyberry Viburnum
5. Excessively wet (poorly drained) mineral soils	Northern white cedar* Silver maple Green ash**	Nannyberry Viburnum "Indigo" silky dogwood Redosier dogwood American cranberry bush
6. Excessively wet (poorly drained) pH>7.4	Northern white cedar* White spruce* Green ash**	Nannyberry Viburnum

[1]For other species, refer to section II-H of the SCS Technical Guide, or the appropriate county soil survey, as available from the USDA Soil Conservation Service.
[2]Indicates species best suited for wildlife food or cover.
*Indicates species best suited for wildlife food or cover.
**Tamarack and willow may also be used, where available.

Source: USDA, Soil Conservation Service Technical Guide #342

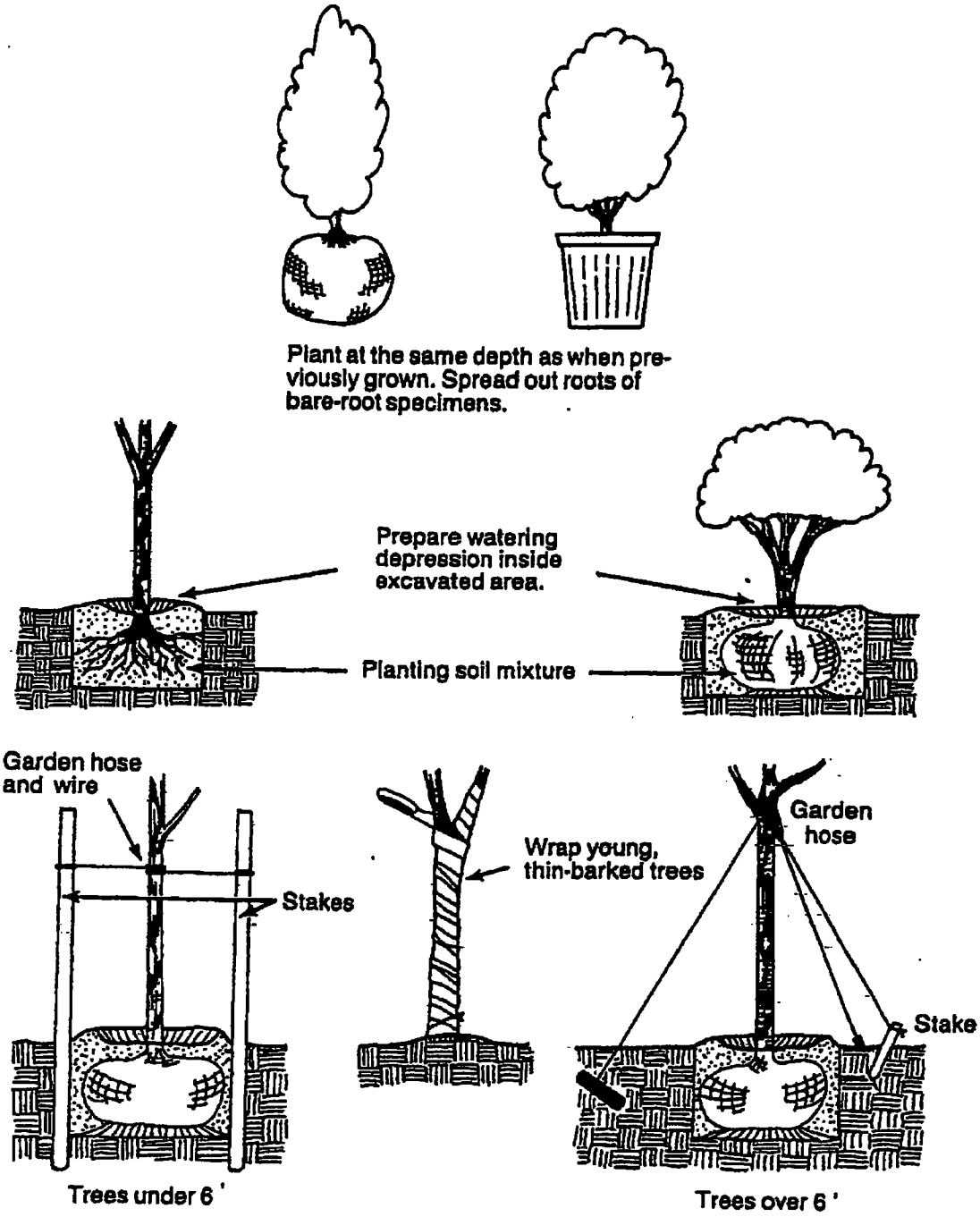
EXHIBIT 2
SELECTING GROUND COVERS

Plant	Height (inches)	Sun	Partial Shade	Shade	Soil	
Buglewood (carpet bugle) (Ajuga reptans)	4 to 8	X	X	X	most soils	One of the best perrenials; spreads rapidly. Parent plant has deep deep green foliage, blue flowers. Gaiety and Metallica Crispa varieties have bronze-purple leaves. Silver Beauty's foliage is cream and light green. Alba is white-flowered.
English Ivy (Hedera helix)	6 to 8	X	X	X	rich, well-drained	Semievergreen to evergreen; covers large or small areas. Look for improved varieties: Baltic, Thornapple, Wilson and others.
Japanese Spurge (Pachysandra terminalis)	up to 6		X	X	fertile, moist	Universally popular evergreen herb. Some plants have small, spiked white flowers sometimes followed by white berries in the fall. Improved forms Green Carpet, Silver Edge.
Juniper* (Juniperus hortizontalis)	12 to 18	X	X		dry areas	Creeping, soft-textured plant; light green to steel blue needles frequently turn purple in winter. Waukegan variety is good. Japanese garden variety is very compact.
Juniper* (J. sabina tamariscifolia)	up to 24	X	X		dry areas	Sometimes called Tamarix Savin juniper. Needle-like silver-green leaves. A good spreader for slopes; use as foreground for deciduous trees or complete ground cover.
Lily-of-the-Valley (Convallaria majalis)	6 to 10		X	X	rich, moist	Fragrant white bell-like flowers; Rosea variety has purplish-pink flowers.
Periwinkle (myrtle) (Vinca minor)	up to 6		X	X	moist, well-drained	Almost universally used. Dislikes humid conditions. Good on slopes, level land or as a backdrop for bulbs. Bowles, a superior variety, has glossier leaves, larger blue flowers. Golden Bowles has gold and yellow foliage with white flowers.
Stonecrop, Goldmoss (Sedum acre)	up to 4	X	X		stony, sandy, dry	Mats of tiny foliage, good between stepping stones and in crevices. Spreads rapidly and can become a weed in grass. The sedum variety, Dragon's Blood, is known for its reddish-brown inch-high foliage and carmine flowers.
Sedum album	up to 4	X	X		sandy, well-drained	Forms mats of attractive dark-green to red foliage on creeping stems. Not as likely to invade grass areas as stonecrop.

* Indicates species best suited for wildlife cover.
Source: USDA, Soil Conservation Service Technical Guide #342.

Exhibit 3

Planting Balled-and Burlapped and Container-Grown Shrubs and Trees

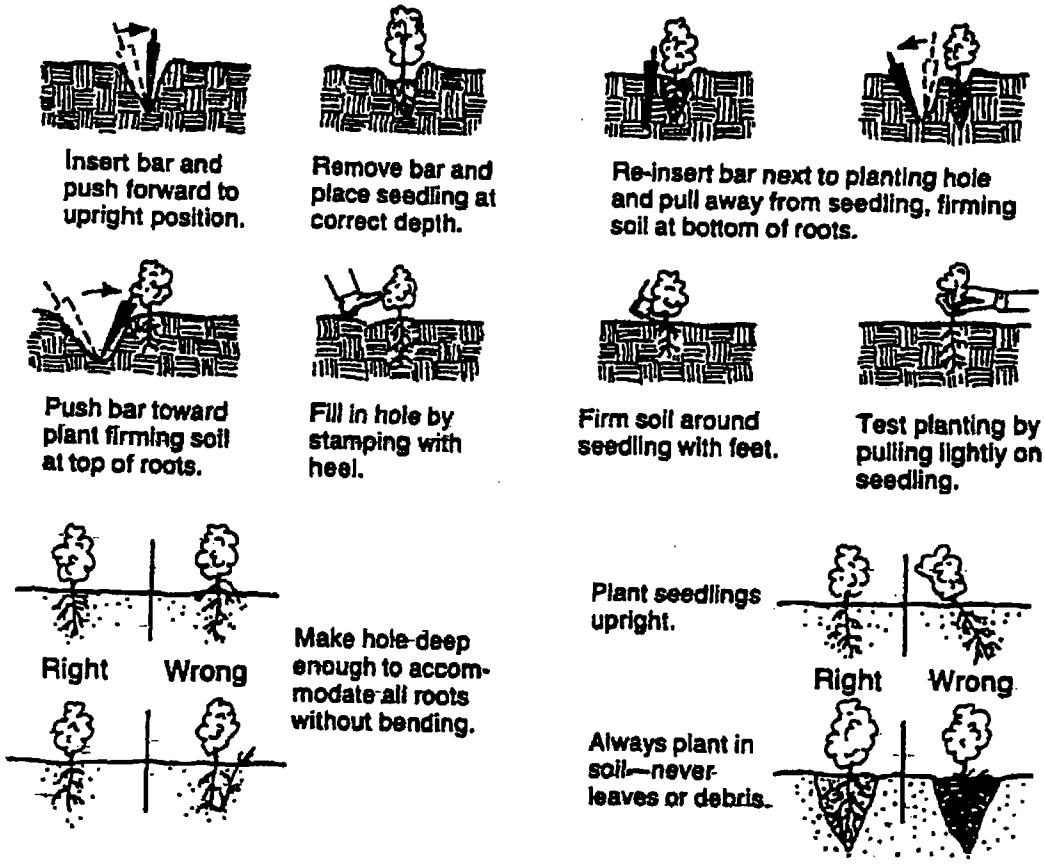


Source: North Carolina Erosion & Sediment Control Planning & Design Manual, as modified from the Virginia Division of Forestry.

Exhibit 4

A Method for Planting Bare-Root Seedlings and Sprigs of Grasses

A method of hand planting bare-root seedlings and sprigged grasses is shown below. With a planting bar/iron or shovel/spade, make a notch in the soil no less than 8 inches deep. Place the roots in the notch to the same depth as the plant was in its original growing container. Firm soil around the roots by pressing the notch closed. Water immediately, and mulch, where necessary, within 2 feet of the plant. Since fertilizers tend to dry out young seedlings, do not fertilize bare-root seedlings until the end of the first year.



Source: North Carolina Erosion and Sediment Control Planning and Design Manual, as modified from the Va. Div. of Forestry.

Exhibit 5

Spacing and Rates of Planting Several Tree Species

Species	Recommended Spacing (Open Planting)		Approx. No. Trees Needed	Acceptable Range
	Between Rows	In Rows	Per Acre	In Rate Per Acre
Jack Pine	8 feet	5 feet	1,050	900-1,200
Spruce & N. White-Cedar	8 feet	6 feet	900	800-1,000
Red Pine	8 feet	7 feet	800	700-950
White Pine	8 feet	7 feet	800	700-950[1]
Hardwood Trees (including black walnut)	10 feet	10 feet	430	400-500[2]
Hardwood Shrubs	6 feet	5 feet	1,450	1200-1800

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[1]Planting white pine is recommended primarily for understocked wooded areas from Jackson County north because of the white pine weevil. The number of seedlings required for interplanting on a per acre basis will usually be less in a wooded area. Most seedlings should be planted in the small openings where they will have significant amounts of sunlight. From Jackson County south, planting white pine in open fields is an acceptable practice, as well as interplanting.

[2]The spacing for hardwood trees depends upon several factors. Hardwood trees will not grow and develop well when spaced as closely together as conifers; however, competing vegetation is much more detrimental to hardwood plantations particularly in the establishment period. The closer spacing is recommended where the vegetation will only be controlled for approximately 3 years. The close spacing will enable the hardwood crowns to close more quickly and shade out the competing vegetation. Closer spacing will, however, require thinning at an earlier date. Wider spacing requires controlling the vegetation more than 3 years or until the crowns close, which may take up to 6 years. The closer spacing is an alternative to controlling the vegetation for longer periods of time.

Source: USDA Soil Conservation Service Technical Guide #612

[redacted] D [redacted]

APPENDIX D

EXTERNAL SPILL REPORT

PORTAGE CREEK AREA TIME CRITICAL REMOVAL ACTION
EXTERNAL SPILL REPORT FORM

1. Reporting

a) Date and time of discharge/release:

b) Date and time of discovery that the discharge had occurred:

c) When and to whom was the release first reported:

d) Indicate the identification number referenced in the cover letter:

e) Who was notified Michigan DEQ/US EPA:

2. Location

a) Mailing address: ___

b) Location of discharge: County, Township, and City: ___

c) Longitude and latitude if source was non-transportation (or enclose copy of a portion of a U.S.G.S. map showing location):

d) Distance and direction from the nearest intersection (or mile point) if transportation related:

3. Product Release

Provide the common and technical name(s) of the material(s) released and CAS Number(s):

_____

Is the product listed under Section 302(a) of SARA Title III or CERCLA 102(a)? (If yes, then a copy of your response to these questions should be sent to your LEPC).

_____

What was the quantity and duration of the discharge? (Indicate volume in gallons or pounds).

_____

What was the cause and source of the discharge/release? _____

_____

_____

4. Environmental Impact

Did the product reach "Waters of the State"? Provide the name of the watercourse. (Underground waters are "Waters of the State".)

What was the length or area of the water affected? _____

If no water was affected, what was the surface area and depth of soil contamination? (Please provide area of soil contamination even when waters are affected.)

_____

_____

Did any evacuation result?

Was any animal or vegetation damage observed?

Were any health effects reported?

Was medical service provided for exposed individuals?

5. Monitoring and Detection

Describe how the release was detected and monitored to determine off-site concentration. (Be specific as to any monitoring system in place at your facility.)

_____

If the release was airborne, how was the wind direction and speed determined?

_____

Was the public warned? If so, how? _____

6. Mitigation, Containment Action

How much product or waste was recovered or neutralized? _____

How was the material recovered or neutralized? _____

Where was the cleanup waste taken? _____

Were any other actions taken to reduce the impact of the discharge (boom, siphon, dams, sorbent)?

_____

7. **Please provide plans to eliminate any future spills, discharges or emissions which may occur at this specific source. This may include: Employee training, replacement of equipment, construction or security measures such as lighting, fencing, or locks.**

_____

_____

_____

8. Health Risks

What protective precautions were taken as a result of the release?

List known or anticipated acute and chronic health risks of exposure to the substances which are released. Cite source(s) of information provided: _____

_____

9. **Indicate any air, water or other permit numbers which may be pertinent to this incident. Please indicate type of permit(s).**

10. **Provide a chronological review of the incident. Include a chronology of communications with state and local government agencies.**

11. **Provide any photographs, reports or other documents whether generated by your company or outside entities which are germane to the incident (e.g., accident reports, manifests, bills of lading, laboratory analysis).**

12. **Describe any extenuating circumstances which caused the discharge.**

13. **Economic Impact (Answering this question is voluntary).**

What was the dollar value, if any of the spilled product? _____

What was the equipment damage cost? _____

What were the costs of spill cleanup? _____

What are the estimated costs of spill prevention to eliminate possible reoccurrence of this event? _____

14. **Provide name, title, and phone number of environmental contact(s) at your company.**

_____

[redacted]

E

[redacted]

APPENDIX E

EXAMPLE INSPECTION REPORT FORM

PORTAGE CREEK AREA TIME CRITICAL REMOVAL ACTION
SOIL EROSION AND SEDIMENTATION CONTROLS INSPECTION FORM

General Information			
Project Name			
		Location	
Date of Inspection		**Start/End Time**	
Certified Inspector's Name(s)			
Certified Inspector's Title(s)			
Certified Inspector's Contact Information			
Certified Inspector's Qualifications			
Describe present phase of construction			

Type of Inspection:
❑ Regular ❑ Pre-storm event ❑ During storm event ❑ Post-storm event

Weather Information

Has there been a storm event since the last inspection? ❑Yes ❑No
If yes, provide:
Storm Start Date & Time: Storm Duration (hrs): Approximate Amount of Precipitation (in):

Weather at time of this inspection?
❑ Clear ❑Cloudy ❑ Rain ❑ Sleet ❑ Fog ❑ Snowing ❑ High Winds
❑ Other: Temperature:

Site-specific Soil Erosion and Sedimentation Controls

	SESC Control	SESC Installed?	SESC Maintenance Required?	Corrective Action Needed and Notes
1		❑Yes ❑No	❑Yes ❑No	
2		❑Yes ❑No	❑Yes ❑No	
3		❑Yes ❑No	❑Yes ❑No	
4		❑Yes ❑No	❑Yes ❑No	
5		❑Yes ❑No	❑Yes ❑No	
6		❑Yes ❑No	❑Yes ❑No	
7		❑Yes ❑No	❑Yes ❑No	
8		❑Yes ❑No	❑Yes ❑No	
9		❑Yes ❑No	❑Yes ❑No	
10		❑Yes ❑No	❑Yes ❑No	
11		❑Yes ❑No	❑Yes ❑No	
12		❑Yes ❑No	❑Yes ❑No	
13		❑Yes ❑No	❑Yes ❑No	
14		❑Yes ❑No	❑Yes ❑No	
15		❑Yes ❑No	❑Yes ❑No	
16		❑Yes ❑No	❑Yes ❑No	
17		❑Yes ❑No	❑Yes ❑No	
18		❑Yes ❑No	❑Yes ❑No	

Overall Site Issues

Below are some general site issues that should be assessed during inspections. Customize this list as needed for conditions at your site.

	SESC/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
1	Are all slopes and disturbed areas not actively being worked properly stabilized?	❑Yes ❑No	❑Yes ❑No	
2	Are natural resource areas (e.g., streams, wetlands, mature trees, etc.) protected with barriers or similar BMPs?	❑Yes ❑No	❑Yes ❑No	
3	Are perimeter controls and sediment barriers adequately installed (keyed into substrate) and maintained?	❑Yes ❑No	❑Yes ❑No	
4	Are discharge points and receiving waters free of any sediment deposits?	❑Yes ❑No	❑Yes ❑No	
5	Are storm drain outfalls properly protected?	❑Yes ❑No	❑Yes ❑No	
6	Is the construction exit preventing sediment from being tracked into the street?	❑Yes ❑No	❑Yes ❑No	
7	Is trash/litter from work areas collected and placed in covered dumpsters?	❑Yes ❑No	❑Yes ❑No	
8	Are vehicle and equipment fueling, cleaning, and maintenance areas free of spills, leaks, or any other deleterious material?	❑Yes ❑No	❑Yes ❑No	
9	Are materials that are potential storm water contaminants stored inside or under cover?	❑Yes ❑No	❑Yes ❑No	
10	(Other)	❑Yes ❑No	❑Yes ❑No	

Non-Compliance

Describe any incidents of non-compliance not described above:

CERTIFICATION STATEMENT

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

State of Michigan Certified Inspector Name and Title:

_____

Signature:_____

Date:_____

APPENDIX F

EXAMPLE CORRECTIVE ACTION LOG

[redacted]

F

[redacted]

PORTAGE CREEK AREA TIME CRITICAL REMOVAL ACTION
CORRECTIVE ACTION LOG

Inspection Date	Certified Inspector Name(s)	Description of SESC Deficiency	Corrective Action Needed (including planned date/responsible person)	Date Action Taken/Responsible person

APPENDIX G

EXAMPLE SEDIMENTATION AND EROSION CONTROL AMENDMENT LOG

PORTAGE CREEK AREA TIME CRITICAL REMOVAL ACTION
AMENDMENT ACTION LOG

Amendment No.	Description of the Amendment	Date of Amendment	Amendment Prepared by [Name(s) and Title]

APPENDIX H

TRAINING LOG

PORTAGE CREEK AREA TIME CRITICAL REMOVAL ACTION
TRAINING LOG

Project Location:

Instructor's Name(s):

Instructor's Title(s):

Course Location: _____ Date: _____

Course Length (hours): _____

Training Topics: *(check as appropriate)*

- ❑ **Erosion Controls**
- ❑ **Emergency Procedures**
- ❑ **Sediment Controls**
- ❑ **Other Controls**

Specific Training Objective:_____

_____

Attendee Roster: *(attach additional pages as necessary)*

No.	Name of Attendee	Company
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		